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(54) **ELECTRICITY SUBSTATION**

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SOUS-STATION ELECTRIQUE

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Description

OBJECT OF THE INVENTION

[0001] The present invention refers to an electrical substation, which presents a series of particularities that affect both the electrical configuration and the physical location of its equipment and even the electrical insulation technology used for the high voltage switchgear, where the new configuration is based on the layout of modules forming longitudinally-linked squares, hereinafter denominated "network ring", while the physical layout of the equipment will be in segregated phases, and the electrical insulation will be based on sulphur hexafluoride (SF6), in which the elements are in insulated, independent chambers forming armoured modules.

[0002] The object of the invention is to achieve an electrical substation whose implementation supposes, among other services, the improvement of safety and reliability aspects for the electrical system, together with optimum availability and flexibility in operating, permitting easy enlargement and the replacement of elements and/or modules without the need for interruptions in the functioning of the substation, and in a very reduced period of time.

BACKGROUND TO THE INVENTION

[0003] In an electrical substation, the fundamental aspects that have to be taken into account for implementation correspond to: the electrical configuration, the electrical insulation technology to be used, and the physical layout of its equipment.

[0004] With regard to the electrical configuration of a substation, this is determined by the layout and interconnection of the different elements that form the equipment in general, such as the circuit breakers, disconnectors, transformers for measuring intensity and voltage, electric bars, etc.

[0005] Different types of configurations are known and those denominated "one and a half breaker", "double bar" and "classic ring" can be quoted as the most important or those habitually employed. A cutoff element (circuit breaker) and various ones for handling (disconnector) are required in each of these for each input and output position of the substation (line, power transformer, reactance, condenser bench, etc) each substation having an indeterminate number of outputs and inputs.

[0006] Of the different types of configuration referred to, that denominated "one and a half breaker" is the most appropriate for critical substations in high voltage, for making the maintenance and operating needs of the system compatible to a great extent (safety, reliability, enlargement, etc) within the cost level acceptable.

[0007] The "double bar" configuration is more economic than the "one and a half breaker" one but offers fewer services with regard to availability and flexibility in operating.

[0008] The "single bar" configuration is more economical but has the inconvenience that behaviour with regard to availability and flexibility is unacceptable for the most critical voltage levels.

[0009] The "classic ring" configuration permits acceptable possibilities for operating at a relatively economic cost, but has the inconvenience that the configuration in itself is very rigid with regard to enlargement.

[0010] With regard to the electrical insulation technology conventionally used, this may be exposed to the elements or conventional, that is to say, using the dielectric characteristics of the air, or sulphur hexafluoride (SF6), also denominated armoured.

[0011] In the first case, important dimensions are required to guarantee the insulation necessary between phases, the insulation being subject to atmospheric agents that can, in an unexpected manner, cause deterioration, premature ageing and faults in the equipment. For its part, the switchgear, that is to say, the group of elements that constitute the substation, can be independent and permit open solutions, or what is the same, each element or device can be from a different manufacturer.

[0012] With regard to the second type of electrical insulation, that is to say, that which uses armoured technology, as the elements are encapsulated in a more insulated environment than air, this permits much more reduced dimensions, with less environmental impact and considerable lower fault indices. On the contrary, they are habitually closed solutions, that is to say, a sole manufacturer exists per installation, forcing dependence on same during the useful life of the substation, in such a way that the repercussions of the faults tend to be serious since they suppose greater unavailability of the installation and affect a greater number of elements, without forgetting that the initial cost is substantially greater than that required for electrical insulation exposed to the elements or conventional.

[0013] With regard to the physical layout, or third aspect that has to be taken into account in an electrical substation, different solutions are conventionally offered depending on the other aspects quoted (configuration and insulation technology), together with the operating needs required, an initial definition being necessary that is difficult to modify in the future. In general, three-phase layouts tend to be defined on three heights.

[0014] For a balanced distribution of load, that is to say, to avoid power flows of great magnitude over the element (for example, a circuit breaker that joins one side and the other of the substation), and to limit accidents, repercussions on other elements outside the problem, it tends to be recommendable to confront generation inputs with consumption outputs and alternate these confrontations in a reciprocal manner. That is to say, if there are two generation/consumption lines face to face, an attempt must be made for the adjacent confrontation to be consumption/generation, which requires large dimensions and crossings on the majority of the occasions, to make the lines arrive on the correct side, with consider-

able economic and environmental cost. US-A-5.589.674 discloses an electricity substation according to the preamble of claim 1.

DESCRIPTION OF THE INVENTION

[0015] The substation in the invention presents the particularity that the electrical configuration is in what has been denominated the "network ring", but not the traditional classic ring, but a special ring whose new characteristic resides in the layout of armoured modules forming longitudinally-linked squares, from whose vertices extend the denominated input/output "positions".

[0016] The armoured modules of the electrical substation in the invention are constituted by a circuit breaker, two transformers for measuring intensity and two disconnectors, with the particularity that each one of these elements is located in an independent chamber insulated from the others, all of these forming the armoured module. The electrical insulation used is sulphur hexafluoride (SF6), without rejecting other fluids.

[0017] The layout of these elements in independent chambers permits the restriction of possible problems, failures not having repercussions on other chambers or elements, guaranteeing with this the service of the rest of the equipment not affected in the module, in addition facilitating later repair and/or maintenance actions.

[0018] On the other hand, the aforementioned independence of the chambers for each armoured module, in combination with the reliability offered by the disconnectors, is of great use in the handling and/or repair of a failed circuit breaker, since they make it possible to perform a complete intervention on the circuit breaker itself and even change the failed part of this, without the need to cut off the voltage at the input/output ends of the module, since it is possible to insulate the fault with the module disconnectors, facilitating the replacement of the rest of the system in a minimum period of time, which supposes a solution to any serious problems originated when this type of breakdown occurs, by using conventional technology for exposure to the elements since, in this case, multiple non-availabilities of longer duration occur, both of the circuit breaker affected and the adjacent ones.

[0019] Returning to the "network ring" configuration in the invention, this allows relatively simple enlargements, without anything further than adding new modules forming squares longitudinally, with minimum influence on the rest of the substation, avoiding non-availability of the service.

[0020] The connection between armoured modules can be carried out in different ways, either by means of a cable or bare aluminium conduit (switchgear exposed to the elements), or by means of an armoured conduit insulated in SF6, or in a mixed manner, that is to say, some connections by means of bare conduits and other connections by means of armoured conduits.

[0021] Furthermore, the ring according to the invention permits closure by joining its two longitudinal ends, which offers possibilities for operating and even higher than those available in conventional "one and a half breaker" configurations.

[0022] As an option, the design considers the installation of three transformers for measuring voltage exposed to the elements through the input/output position, one for each phase of electricity, in such a way that one of the transformers is connected electrically to the vertex associated with the ring, while the other two are connected to the "position" after the output disconnector, in this case it being possible to be of the capacitor type to allow communication methods by a carrier wave to be employed, which permits the resources of these elements to be optimised, having the voltage both for the measurement and for the protection and checking of synchronism (for closing the circuit breakers) and the requirements for the communications system by carrier wave in a simple and economic form.

[0023] Another advantage supposed by the "network ring" configuration in the invention is the disappearance of the classic connection bars (aerial conductors or aluminium tube) and their associated differential protection, with the consequent economic and space savings.

[0024] Likewise, it should be highlighted that these armoured modules accept combinations with other components of technology for insulation exposed to the elements, furthermore permitting the development of any type of electrical configuration, making mixed configurations possible, that allows enlargements of the "one and a half breaker" configuration on an installation to be confronted, for example of a "one and a half breaker".

[0025] Other advantages offered by this technology are the following:

- It permits the execution of complete "positions" by phases, totally checked in the factory and transported without disassembly, which decreases the assembly and test times in the location of the substation, together with the risk of errors in assembly.
- The sole criterion for standardisation of the modules permits the use of these in all substations, independently of the type of insulation and the configuration that each substation has or it is anticipated that it will have. In this way, the engineering, maintenance, assembly costs, etc. are reduced.
- It also offers the advantage that it permits any of the components in the armoured module to be substituted, including a pole of a circuit breaker, in a maximum time that can be estimated at 6 hours, without the need for specialised means or personnel, as opposed to that which occurs conventionally where the time is very high, with specialised personnel and requiring discharges to be made from certain parts of the substation.
- Equally, the use of the double transformer for measuring intensity for each module permits the overlapping of the adjacent protection zones, in such a way

that no areas are left unprotected, making the location of failures in the interior of the modules possible and proceeding with the substitution where necessary.

- It is equally fitting to highlight the fact that the armoured modules are immune to atmospheric or environmental agents since they do not contain any external moving parts.
- Finally, as another advantage, the fact should be highlighted that the elements exposed to the elements subject to atmospheric agents are fewer, so that the risks both through faults and failures are reduced.

[0026] Another new characteristic incorporated in the electrical substation in the invention is that it has the phases segregated, that is to say, that the rings that they form by phases are independent, preventing the formation of short circuits between phases and permitting physical layouts in the different switchgear to be adopted, whether in a ring, in a line or even mixed, in accordance with the space requirements or the arrival of the different positions (input/output), in such a way that the layout in a line provides in a natural manner the inversion of the load line that arrives physically in the same side of the substation, permitting alternating generation/consumption and avoiding the crossing of lines.

[0027] Based on the segregation of the phases, it is possible to carry out implementation both externally and internally, making it possible with the same configuration for the substation connection with the transport lines to be performed using both an overhead lead and with an insulated cable, and also with an SF6 armoured conduit or a combination of any of the previous solutions.

[0028] External implementation or exposed to the elements with a "network ring" configuration is based on the overhead layout of four bare conductors to make the connection of the three phases of each one of the inputs/outputs that access these possible, by means of bridges to establish in phase electrical continuity.

[0029] This layout or implementation is that which gives place to the segregation of the phases, permitting the interconnection of the different inputs/outputs to and from the substation, with this avoiding the surrounding routes and crossings between lines that are produced generally and conventionally in existing substations.

[0030] In the external implementation, the layout of the conductors can be on one or two height levels, while in the internal implementation, the layout of the modules is made in a building with one or various floors, accesses being permitted for inputs/outputs of the modules, in such a way that any connection required is possible in practice, with low costs for the aforementioned installations.

[0031] In the aforementioned implementation exposed to the elements two levels are established, one corresponding to the modules that form the rings and the other corresponding to the connection conductors, and it is possible to define or establish a third level for connections that permit lateral outputs or crossing between lines or even the closing of the ring to be made, which avoids making crossings away from lines, as well as providing greater facilities for operating and greater compaction.

[0032] The fact should equally be highlighted that the segregation in the "network ring" configuration makes it possible to establish a modularity that, with minimum changes in the project, permits layouts that are unheard of in any other solution of those used up to the moment in high voltage substations, all of this in such a way that base elements of equal physical configuration will be able to be performed with the same means of location and assembly, that is to say, standardised, in such a way that those base elements will have common characteristics with minimum variations, which permits them to be constructed and tested in the factory and later transferred and assembled in the substation without any engineering work, since removal and connecting will always be the same and the variations they have among them will be foreseen solely to be able to carry out, in some cases, for example, an enlargement of the substation and, in other cases, for example, for making lateral outputs, etc. in precise terms being able to implement a substation as if it were a puzzle.

[0033] By means of the aforementioned modularity, the delivery times are less, as will be the assembly time, independently of any enlargement or modification not needing to leave a part of the substation out of service. Furthermore, due to the modularity, the implementation of the base elements and/or implementation of a substation and enlargement of this is possible, in any place, whatever the land relief.

[0034] The dimensions of the substation based on the novelty aspects referred to previously, with respect to an equivalent of, for example, a "one and a half breaker", are much more reduced both with respect the total surface area necessary and the height, which in combination with the possibility of choosing different colours for the armoured modules, permit the environmental impact to be reduced in a significant manner.

[0035] On the other hand, the layout of the segregated phases carries with it the advantage of totally avoiding in practice the possibility of short circuits between phases occurring inside the substation, which notably improves the efficiency of these substations in the global electricity system.

[0036] Equally, and as another of the advantages, the fact can be quoted that the segregated "network ring" configuration permits users of the installation or substation to be able to carry out later enlargements with armoured modules from manufacturers who are different from those used in the initial installation or substation, always provided that they comply with certain basic characteristics that it is easy to comply with for any of the manufacturers of this type of equipment.

[0037] The execution of an electrical substation based on the aforementioned segregated "network rings" and with armoured modules can present certain limitations

when voltages reach 400 KV, since from these voltages the total assembly and tests can only be carried out in the installations of the manufacturer of each one of the modules, but not of the group of these, that is to say, not a complete substation.

[0038] Therefore, to permit the development of a substation of 400 KV or higher voltages without problems, an alternative to the execution of a ring has been foreseen, based on which it is possible to carry out the total assembly and tests in the installations of the manufacturer himself, in such a way that only the assembly of the bushings or connections to cables required will be necessary in the installation or substation.

[0039] More specifically, the alternative to the execution of the ring in the invention consists of a compact ring whose four armoured modules are to be found in a layout grouped on two levels; that is to say, with two modules on one level and the other two modules on another level, in such a way that on one of the ends the modules on each level are connected to each other, while on the opposite end each module on one level is connected to the module on the other level, thus obtaining the electrical schematic of the corresponding ring, with the same particularities and characteristics as those of the "network ring" previously described. Evidently, the aforementioned layout in a compact ring on two levels will be implemented in each one of the three electricity phases in the installation.

[0040] The execution of this layout in a compact ring permits the development of high voltage substations, being of particular application in 400 KV ones and even those of higher voltages, in such a way that the total assembly and tests may be carried out in the installations of the manufacturer himself, carrying out the transport to the substation, in which only the assembly of the bushings or connections to cables will be necessary, permitting the successive growth of the substation by means of the addition of similar groups, that is to say, of compact rings on two levels.

[0041] As has already been said, each compact ring on two levels is formed by four armoured modules, in this case up to four inputs/outputs being usable, in such a way that the application for the connection of a greater number of inputs/outputs can be done by means of successive additions of compact rings, but only three modules and two inputs/outputs for each addition, the missing module being substituted by a simple SF6 gas connection.

[0042] The implementation is performed by means of segregation of the three existing phases in the high voltage systems, segregation that can be done at the same level or on different levels, according to the needs of each case, the layout to be adopted depending on the type of output selected, since with four inputs/outputs by cable the layout has practically no other restrictions than those of the physical space that the dimensions of the compact rings has, with regard to whether higher outputs by Bushing (air insulation bushing, for connecting to an insulated conduit) are used, these require dimensional space for insulation according to the standards and voltage level.

[0043] The following can be quoted among the advantages that can be obtained from this layout with a compact ring on two levels:

- Maximum use of space.
- Minimum impact on the surroundings.
- Minimum cost of the armoured installation on reducing the length of the armoured connections necessary to the maximum.
- Maximum modularity and, as a consequence, adjustment of the cost of the installation to its real needs at all times of its life.
- Maximum reliability. Permitting the overall substation to be manufactured, assembled and tested in the factory and transported to the place of installation without the need for any other disassembly than that of the input/output bushings.
- Minimum installation and testing times.
- Reduction of costs through standardisation in that manufactured for the substations, a level clearly higher than the present one existing at these voltage levels, in which until now the objectives were put at the level of the compact manufacture of modules, a previous and lower level to that of the substation, of which they are components.
- The possibility of making the materials of different manufacturers compatible, as a consequence of the modularisation existing. That is to say, the compact rings of any manufacturer - can be used and enlarged with compact rings from another different manufacturer.
- It permits different layout possibilities for each one of the modules, to adapt them to the technical characteristics of each one of the manufacturers and the characteristics and location of their respective managements and external dimensions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] In order to complement the description to be given below and with the object of helping to have a greater understanding of the characteristics of the invention, this descriptive report is accompanied by a set of drawings on the basis of which the innovations and advantages of the electrical substation that is the object of the invention will be understood more easily.

Figure 1.- Shows the schematic corresponding to a conventional "one and a half breaker" configuration, used in electrical substations, according to a single wire representation.

Figure 2.- Shows the schematic corresponding to a conventional "classic ring" configuration, used in electrical substations, according to a single wire representation.

Figure 3.- Shows the schematic corresponding to a

need for crossings required for alternating generation/consumption, in a used in electrical substation with a "one and a half breaker" configuration, in a single wire representation.

Figure 4.- Shows the schematic corresponding to the "network ring" configuration, used in the electrical substation in the invention, in a single wire representation.

Figure 5.- Shows the schematic in the previous figure with the ring closed over it.

Figure 6.- Shows the schematic corresponding to an armoured module in the electrical substation in the invention, with the independent chambers for the circuit breaker, for each of the two intensity transformers and for each of the disconnectors.

Figure 7.- Shows the schematic corresponding to the combination between a conventional one and a half breaker configuration configuration, used in the electrical substation in the invention and the "network ring" configuration that forms part of the object of the invention, in a single wire representation.

Figure 8.- Shows the schematic corresponding to the form of segregation of the phases in the "network ring" configuration of the invention, with two levels, one corresponding to the ring modules and the other corresponding to the conductors or connection lines.

Figure 9.- Shows a schematic like the one in the previous figure, but showing the arrival of lines on the opposite side.

Figures 10, 11 and 12.- Show other schematics in a single wire representation of a ring configuration, in line and mixed, with the same armoured modules, all in accordance with the object of the invention.

Figure 13.- Shows the schematic corresponding to the form of achieving natural alternating of generation/consumption, starting with a ring configuration in order to reach an in-line configuration without having varied the modules.

Figure 14.- Shows a schematic like that in figure 8, but including a third level for crossings.

Figure 15.- Shows a schematic like that in figure 8, but including a third level for a side output.

Figure 16.- Shows a physical representation of the "ring network" configuration with the installation in a building, three heights being seen, one for each phase.

Figure 17.- Shows a ground view of the previous figure 8. -

Figure 18.- Shows a ground schematic representation of a sector of an electrical substation that is the object of the invention, according to views corresponding to the different levels, with a detail in a square allowing the different elements to be seen.

Figure 19.- Shows a raised ground schematic view of that represented in the previous figure.

Figure 20.- Shows a physical representation according to the general perspective of a compact ring on two levels, in accordance with an alternative of the execution corresponding to an improvement in the invention.

Figure 21.- Shows a schematic representation of the way in which to carry out the enlargement of an installation by means of adding successive compact rings with only three modules.

Figure 22.- Shows a view in perspective such as that of figure 20, with the layout of upper outputs by bushing (6) and lower ones by cable (7).

DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

[0045] In view of the figures commented on and making reference specifically to figure 1, the schematic representation of a conventional "one and a half breaker" configuration can be observed, with the main electric bar B1 and B2, the L1-L2, L3-L4, L5-L6 input/output positions, together with a possible future L-L' input/output position, according to a representation with the dashed line. Between the main bars B1 and B2 the I circuit breakers, the TI intensity transformers and the S disconnectors are arranged, for each phase, together with the S' grounding disconnectors incorporating the TT voltage transformers and the B blocking coils at the outputs, all in accordance with the single-wire representation of this figure 1.

[0046] The classic ring configuration is shown in figure 2, with the L1 input/output positions, showing on the ring the I circuit breakers, the TI transformers and, in positions L1, L3 and L5, the corresponding TT voltage transformers, the B blocking coils and the S' grounding disconnectors.

[0047] A schematic configuration of the conventional one and a half breaker is shown in figure 3, between whose bars B1 and B2 only I circuit breakers have been represented, since the rest of the components have not been represented, in the same way as they have not been represented in the generation/consumption positions 1, 2 and 3, all this in order to avoid complexities, as the sole intention of figure 3 is to show the need for crossings for alternating generation/consumption, since the convenience of confronting generation/consumption requires, in this conventional configuration, carrying out a crossing for alternating this generation/consumption, a crossing which leads to the need for large dimensions to make the lines arrive at the adequate side.

[0048] These problems are resolved by means of the novelty aspects considered in the electrical substation in the invention, where the configuration is of a "network ring" as shown in figure 4, but not a classic ring like the one shown in figure 2, but a ring that is configured by arranging, segregating the phases, in armoured modules M forming longitudinally-linked squares, from whose vertices the L1-L2, L3-L4, L5-L6 input/output positions start, offering the possibility of enlargement without any type of problem, according to position L-L', represented with a dashed line. In this figure 4, each armoured module M

is made up of an I circuit breaker, two TI intensity transformers and two S disconnectors, complemented by the S' grounding disconnectors, while in the positions L1-L2 and the rest they have a TT voltage transformer and B blocking coil arranged in each phase, in such a way that one of the transformers is connected to the respective vertex of the corresponding ring, while the other two, one per phase, are located in the corresponding "position" after the S' output disconnector.

[0049] This configuration, in accordance with that shown in figure 4, allows relatively simple enlargements by simply adding new squares or rings longitudinally, with minimum influence on the rest of the substation, avoiding service unavailability, while allowing connection between armoured modules M without distinction, either by means of cable or a bare aluminium conduit, or by means of a mixed solution, that is to say, with bare conduits and others by means of armoured conduits.

[0050] Likewise, the "ring network" configuration referred to allows its closure by means of line C shown in figure 5, joining the ends of the arrangement of M modules arranged longitudinally, providing operating possibilities similar and even higher than those available in conventional "one and a half breaker" configurations.

[0051] With regard to the TT voltage transformers connected to the corresponding L1-L2, L3-L4, L5-L6 or L-L' positions, as mentioned previously, they are connected after the corresponding S' output disconnector, these TT transformers having the possibility of being of the capacitive type to allow the use of communication methods using a carrier wave and, in this way, optimising the resources of these elements, using the voltage both for measuring and for protection and checking of the synchronism and the requirements for the communications system using a carrier wave in a simple an economic manner.

[0052] With regard to M armoured modules, they will be standardised and will include, as stated previously, an I circuit breaker, two TI intensity transformers and two S disconnectors, complemented with the S' grounding disconnectors, with the particularity that each of these elements is arranged in an independent chamber and insulated by means of SF6, as it can be seen in figure 6 that circuit breaker I will be in an insulated CI chamber independently of the CT chambers where the TI intensity transformers are located, in the same way as the CI chamber of the circuit breaker, in an insulated and independent manner from the CS chambers corresponding to the S disconnectors.

[0053] The layout of independent, insulated chambers, for each element, will permit the restriction of possible problems, faults not affecting other compartments, in such a way that the service of the rest of the equipment of module M not affected is guaranteed, this being a characteristic that as an addition enables later repair or maintenance actions.

[0054] On the other hand, based on this independence between the chambers referred to and the reliability that the S disconnectors offer, they are specially useful in the case of a fault in circuit breaker I, as it allows the whole intervention to be carried out, even the change of the unit, in circuit breaker I without the voltage having to be cut off from the ends of the M module, with which the M armoured modules allow the fault to be insulated with the S disconnectors, enabling the replacement of the rest of the system in minimum period of time.

[0055] On the other hand, the armoured modules M admit combinations with another series of technology elements for protection in the open, as shown in figure 7, where there is a part with a "one and a half breaker" configuration, with bars B1 and B2, I circuit breaker and positions L1-L2, L3-L4 and position L-L' for enlargements, to connect with the "ring network" configuration based on the armoured modules M with input/output positions, also indicated with a dashed line, as an enlargement that forms part of that determined by the aforementioned M modules in figure 7. That is to say, the integration of the elements defined by M modules allows the development of any electric configuration, enabling mixed configurations and, in this sense, allows enlargements to be undertaken in a "ring network" configuration on a "one and a half breaker" installation as shown in this figure 7.

[0056] Figures 10, 11 and 12 show a ring configuration formed for M armoured modules, identified with internal reference 1, 2, 3 and 4 respectively, allowing different physical layouts to be adopted, with the possibility of going from figure 10 to figure 11 where the physical layout is in a line, while figure 12 shows a mixed combination, that is to say, a combined physical layout of rings and line, always with the same representation with regard to single-wire arrangements (ring).

[0057] Figure 13 shows how the layout can be changed from a ring to another one in line, in which in a natural way the electric inversion of the connection of loads that physically arrive on the same side of the substation can be carried out, allowing alternating generation/consumption and avoiding crossings between lines.

[0058] With regard to the physical layout of the segregated phases, in accordance with that shown in figures 8, 9, 14 and 15, it should be said that two levels are shown in figure 8, one corresponding to independent A rings formed by armoured modules M with the elements for their connection to respective phases Ø0, Ø4 and Ø8 of positions L1-L2, in such a way that this level formed by A rings is connected to the phases referred to, these determining a second level, and where the three phases are defined by four conductors, two of them referred to with letters X and Y, and the other two referred to with the letter Z, with the particularity that the first two only correspond to Ø0 and Ø8, these phases being completed with independent sections X' and Y', respectively, belonging to Z conductors, these last two forming the third phase, with the particularity that the electrical continuity of the conductors is made by means of P bridges, since all of them are divided into sections, logically having foreseen that independent sections X' and Y' cannot be

bridged with Z conductors since a short-circuit would occur since they are of different phases.

[0059] If figures 8 and 9 are observed and compared, it can be checked how vertex V or ring A on the right is connected, in figure 8, with conductor X, while vertex v1 of this same ring A is connected with the section of conductor X' in that same phase, while in figure 9 they are connected the other way round, that is to say, vertex V connected to section X' and vertex V' connected to conductor X, but in both cases to phase Ø0, with the possibility of checking how alternating is carried out without crossings, only taking advantage of the fact that one independent section X' or Y', useless for the Z conductors of a phase, can be used to define the other phases X and Y, respectively.

[0060] Therefore, in the case of wanting to modify the physical layout of the elements, it will be sufficient to cancel the P bridges and reposition them in another way, all based on using four conductors to determine the three electric phases.

[0061] By means of this layout, a third level could be used for lateral outputs as shown in figure 14, in which positions L1 and L2 are on the same plane, while the phases that correspond to the lateral outputs are on another higher plane, according to a trajectory layout perpendicular to the phases of positions L1 and L2 referred to previously, establishing the connection by means of the corresponding P bridges.

[0062] The implementation of the third level for the lateral outputs is specifically shown in figure 15.

[0063] Therefore, this third level allows another layer of connections to perform lateral outputs as can be seen in figure 15, crossings between lines or electric bars as shown in figure 14, or the ring closure itself, offering greater facilities for operating and greater compacting, while avoiding line crossings far away.

[0064] The technical layout in segregated phases also admits internal installation as shown in figures 16 and 17, with the layout of M modules inside a building referred to as E in general, with one or various floors, figure 16 showing three floors, one for each phase, and a ground view of figure 16 being represented in figure 17, showing the "ring network" configuration on the E building itself.

[0065] As an example of the modularity provided by the use of the M armoured modules and the segregation of phases, together with the physical layout of the equipment, below and in accordance with figures 18 and 19, a substation open to the elements with six inputs/outputs will be considered, defining the basic standard three-dimensional elements F, G, K that are inter-connectable with each other to make up the configuration sought. In the example of figure 18, the base elements F and K, with references in the three levels as F1, F2, F3 and K1, K2, K3, correspond to input/output position connections, while base elements G, referred to with G1, G2 and G3 for the three levels, are base elements that contain the M armoured modules, in such a way that the combination of these elements F, G and K provides different alternatives for resolving situations of difficult implementation, such as areas with drops, river beds, etc.

[0066] With the purpose of understanding the area or part occupied or corresponding to the base elements F, G, K, in figure 18, a detailed square showing base elements F1, G1, K1; F2, G2, K2 and F3, G3, K3 has been provided, showing squares G1 and F2 as an example, with two arrows, and their correspondence with the base elements framed in a shaded manner over figure 18 itself.

[0067] Obviously, these are base elements that, being standard, can be assembled and connected in a grouped manner or independently, with the purpose of adapting to the different physical conditions that may be given at the locations available to the substation. In figures 18 and 19 it is shown how F base elements are foreseen for lateral outputs, this being the area on the left, represented in figure 19, being the space scarcely occupied by that base element for connection which can be taken advantage of for implementing other components, such as a TP power transformer, the same happening in the area for location of K base elements, where other elements can also be implemented, as it is occupied only with the means for connection to the electric bar or the lines located at a higher level, while base element G, corresponding to armoured modules M, occupies the entire area.

[0068] Obviously, the aforementioned base elements F, G and K can be exactly equal and allow extensions on both sides, or some are ready for only allowing one lateral output, condemning that side to, as occurs with that shown in figures 18 and 19 with base element F, or being seen as allowing for any kind of enlargement, on the other hand, as occurs with the K module on the right hand side, although the base elements are standard in all cases and only vary in the type of connection, offering the possibility of being implemented in the same manner on foundations already existing on the terrain.

[0069] In the execution alternative shown in figures 20, 21 and 22 an A' compact ring with levels N1 and N2 can be seen, where one of the ends, both of the M1 armoured modules at level N1 and of the M2 armoured modules at level N2, are joined by means of a B1 bar in the first case and by means of a B2 bar in the second case, while at the other end of these armoured modules M1 and M2 the join is made by means of B4 bar that joins the end of armoured module M1 at level N1 with the respective armoured module M2 at level N2, forming in this way the ring in which armoured modules M1 and M2 make up, as mentioned above, a circuit breaker, two voltage measurement transformers, two insulation disconnectors and two grounding disconnectors.

[0070] The A' compact ring referred to forms a block or modular set with four inputs/outputs, allowing the successive growth of a substation by means of adding similar and modular sets. Specifically, figure 21 shows a ring or set A' determined according to the physical configuration of figure 20, to which a second ring or set A" is added, without one of the M2 armoured modules, and where four

inputs/outputs are seen for the A' set or ring and two inputs/outputs for the A" set, giving six inputs/outputs as the result of the sum.

[0071] Figure 22 shows the ring or set represented in figure 20 with an arrangement of D upper outputs by bushing and D' lower outputs by cable, all this as an example since the arrangement of the outputs can be varied according to needs and availability of space, that is to say, with phases segregated at the same level or at different ones.

Claims

1. **ELECTRICITY SUBSTATION**, defined by:
   an electric configuration comprising interconnections of elements that form the electrical substation, selected from: circuit breakers, disconnectors, intensity measurement transformers, voltage measurement transformers, electric bars and combinations thereof;
   electric insulation technology used, selected from:

      outdoor insulation using air as dielectric insulator, and
      elements encapsulated within armoured modules in an insulating environment selected from SF6 (sulphur hexafluoride) and other insulators; and
      a physical layout of electric phases;
      the electric insulation technology comprising independent and insulated chambers by means of said insulating environment, for elements selected from the circuit breaker I, the intensity measurement transformers TI, the disconnectors S and the grounding disconnectors S'; and the physical layout of the electrical phases being implemented in a segregated manner , enabling a connection of converging input/output positions L, regardless of its layout in case the input/output positions L are lines, avoiding crossing of lines and surrounding routes, also enabling a physical layout of the armoured modules M to be selected from ring, line and mixed;
      said electrical substation being **characterised in that**:

         the electric layout is implemented by means of single-phase armoured modules M, forming longitudinally-linked electrical squares, respective positions L projecting from each of said electrical squares; each of the armoured modules M being comprised by: a circuit breaker I, two intensity measurement transformers TI, two disconnectors S and two grounding disconnectors S'.

2. **ELECTRICITY SUBSTATION,** according to claim 1, **characterised in that** the armoured modules M are interconnected by means of a bare aluminium cable or tube, and/or by means of a SF6 insulated armoured conduit.

3. **ELECTRICITY SUBSTATION,** according to any of the previous claims, **characterised in that** the "ring" layout is able to be closed by means of a conductor C which joins the longitudinal ends corresponding to the arrangement of the armoured modules M that are interconnected to each other.

4. **ELECTRICITY SUBSTATION,** according to any of the previous claims, **characterised in that** in each input/output position L of the rings A, three measurement voltage transformers TT are included, one connected to the associated vertex of the respective ring A, and the other two, connected after the output disconnector S' which is established in the input/output position L.

5. **ELECTRICITY SUBSTATION,** according to any of the previous claims, **characterised in that** the "ring" configuration is enabled to form an enlargement of a conventional configuration, by means of connecting it to said conventional configuration, determining mixed configurations.

6. **ELECTRICITY SUBSTATION,** according to any of the previous claims, **characterised in that** the implementation of phases Ø0, Ø4, Ø8 in a segregated manner is accomplished by means of an external installation, by means of a layout of the conductors corresponding to the phases, at one or two height levels, while the rings A comprised by armoured modules M are arranged at a lower level and independently connected to phases Ø0, Ø4, Ø8, the three phases of each connection level being defined by four conductors X, Y, Z, where each conductor is comprised by several sections susceptible to connected to each other by means of bridges P in order to establish electric continuity in each conductor or phase, and in order to establish the interconnection of the different inputs/outputs at the nodes V and V' of the most convenient rings A, independently of the topology of the arrival of the inputs/outputs at the substation, two of these conductors corresponding only to both phases, which are completed by means of an insulated section belonging to the other two conductors corresponding to the third phase.

7. **ELECTRICITY SUBSTATION**, according to claim 6, **characterised in that**, in the implementation of phases Ø0, Ø4, Ø8 in a segregated manner, two of the conductors (X and Y, for example) correspond to either phases Ø0 and Ø8, said phases being completed by means of an insulated section X' and Y' belonging to the other two conductors Z which de-

termine the third phase Ø4.

8. **ELECTRICITY SUBSTATION,** according to any of the previous claims, **characterised in that**, with modules connected by means of insulation in SF6, the implementation is accomplished by means of an indoors facility with the layout of the different armoured modules M of the rings, in a building E with one or more floors in height.

9. **ELECTRICITY SUBSTATION,** according to the previous claims, **characterised in that** it comprises base and standarised elements F, G, K.

10. **ELECTRICITY SUBSTATION,** according to claim 9, **characterised in that** the composition of the electrical substation is implemented by means of standard base elements F, G, K, independently or in partial or total groups of said elements.

11. **ELECTRICITY SUBSTATION,** according to any of claims 9 and 10, **characterised in that** the base and standard elements F, G, K include connections for connection with each other, or for permitting lateral outputs to be established or an enlargement of the substation .

12. **ELECTRICITY SUBSTATION,** according to any of claims 9, 10 and 11, **characterised in that** the base and standard elements G include the corresponding armoured modules M with appropriate connections for connecting with other same base elements or with base elements F and K for lateral outputs or for enlargements.

13. **ELECTRICITY SUBSTATION,** according to any of the previous claims, **characterised in that** the connections between transport lines and the substation are indistinctly accomplished by means of an overhead conductor, insulated cable, armoured conduits with SF6 and combinations thereof.

14. **ELECTRICITY SUBSTATION,** according to claim 1, **characterised in that** the ring A' is a compact ring comprising two pairs of armoured modules M1 and M2, according to a layout at two levels N1 and N2, provided with the three phases segregated at the same level or at different levels, enabling the development of high voltage substations, being of particular interest for 400 kV and higher voltages.

15. **ELECTRICITY SUBSTATION,** according to claim 14, **characterised in that** modules M1 and M2 of each level N1 and N2 are joined to each other at one of their ends by means of a bar B1 and B2, respectively, while at the other end the module of each level N1 is joined to that of the other level N2, by means of a vertical bar B4, determining the corresponding ring electric layout.

16. **ELECTRICITY SUBSTATION,** according to any of claims 14 and 15, **characterised in that** compact ring A' is modular at two levels N1 and N2, determining a set or ring with four inputs/outputs, enabling the addition of other set or sets of rings A" provided with the same characteristics, in order to achieve an enlargement of the substation, each additional set A" comprising three armoured modules and two inputs/outputs, the remaining armoured module being implemented by means of a simple connection.

Patentansprüche

1. Elektrizitäts-Umspannstation, definiert durch:

   eine elektrische Konfiguration, die Verbindungen von Elementen untereinander aufweist, welche die elektrische Umspannstation bilden, die ausgewählt sind aus:
   Stromkreisunterbrechern, Trennschaltern, Intensitätsmessumformern, Spannungsmessumformern, elektrischen Schienen und Kombinationen daraus;
   die verwendete elektrische Isolationstechnologie, die ausgewählt ist aus:
   der Freiraumisolation, in der Luft als dielektrischer Isolator verwendet wird, und
   Elementen, die in armierten Modulen gekapselt sind, in einer isolierenden Umgebung, die ausgewählt ist aus SF6 (Schwefelhexafluorid) und anderen Isolatoren; und
   ein physikalisches Layout der elektrischen Phasen,

   wobei die elektrische Isolationstechnologie mittels der isolierenden Umgebung unabhängige und isolierte Kammern für die Elemente aufweist, die aus dem Stromkreisunterbrecher I, den Intensitätsmessumformern TI, den Trennschaltern S und den Erdungstrennschaltern S' ausgewählt sind; und
   wobei das physikalische Layout der elektrischen Phasen in einer getrennten Weise realisiert ist, die eine Verbindung von zusammenlaufenden Eingangs-/Ausgangs-Positionen L erlaubt, unabhängig von ihrem Layout, falls die Eingangs-/Ausgangs-Positionen L Leitungen sind, wobei Leitungskreuzungen und Umgehungswege vermieden werden, wobei auch ein physikalisches Layout ermöglicht wird, in dem die armierten Module aus einem Ring, einer Leitung und Mischformen ausgewählt sind;
   wobei die elektrische Umspannstation **dadurch gekennzeichnet ist, dass**:
   das elektrische Layout mittels einphasiger armierter Module M realisiert ist, die längsseitig verbundene elektrische Vierecke ausbilden, wobei jeweilige Po-

sitionen L von jedem der elektrischen Vierecke abgehen, wobei jedes der armierten Module M aus einem Stromkreisunterbrecher I, zwei Intensitätsmessumformern TI, zwei Trennschaltern S und zwei Erdungstrennschaltern S' gebildet ist.

2. Elektrizitäts-Umspannstation nach Anspruch 1, **dadurch gekennzeichnet, dass** die armierten Module M mittels eines blanken Aluminiumkabels oder -rohrs und/oder mittels eines SF6-isolierten armierten Leitungskanals untereinander verbunden sind.

3. Elektrizitäts-Umspannstation nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das "Ring"-Layout in der Lage ist, mittels eines Leiters C geschlossen zu werden, der die Längsenden entsprechend der Anordnung der armierten Module M verbindet, die untereinander verbunden sind.

4. Elektrizitäts-Umspannstation nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** in jeder Eingangs-/Ausgangs-Position L der Ringe A drei Messspannungsumformer TT enthalten sind, von denen einer an den dazugehörigen Scheitelpunkt des jeweiligen Ringes A angeschlossen ist und die anderen zwei nach dem Ausgangstrennschalter S' angeschlossen sind, der in der Eingangs-/Ausgangs-Position L eingerichtet ist.

5. Elektrizitäts-Umspannstation nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die "Ring"-Konfiguration in der Lage ist, durch ihren Anschluss an die herkömmliche Konfiguration eine Erweiterung einer herkömmlichen Konfiguration auszubilden, wobei Mischkonfigurationen festgelegt werden.

6. Elektrizitäts-Umspannstation nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Realisierung der Phasen Ø0, Ø4, Ø8 in einer getrennten Weise mithilfe einer externen Installation mittels eines Layouts der Leiter, die den Phasen entsprechen, auf einer oder zwei Höhenebenen ausgeführt ist, wobei die Ringe A, die durch armierte Module gebildet werden, auf einer niedrigeren Ebene angeordnet und unabhängig an die Phasen Ø0, Ø4, Ø8 angeschlossen sind, wobei die drei Phasen einer jeden Anschlussebene durch vier Leiter X, Y, Z festgelegt sind, wobei jeder Leiter durch einige Abschnitte gebildet wird, die für eine Verbindung miteinander mittels Brücken P ausgebildet sind, um die elektrische Kontinuität in jedem Leiter oder jeder Phase herzustellen und um die Verbindung zwischen den verschiedenen Eingängen/Ausgängen an den Knoten V und V' der am meisten geeigneten Ringe A herzustellen, unabhängig von der Topologie des Einlaufens der Eingänge/Ausgänge an der Umspannstation, wobei zwei von diesen Leitern nur den beiden Phasen entsprechen, die mithilfe eines isolierten Abschnitts vervollständigt werden, der zu den anderen zwei Leitern gehört, die der dritten Phase entsprechen.

7. Elektrizitäts-Umspannstation nach Anspruch 6, **dadurch gekennzeichnet, dass** in der Realisierung der Phasen Ø0, Ø4, Ø8 in einer getrennten Weise zwei der Leiter (zum Beispiel X und Y) den beiden Phasen Ø0 und Ø8 entsprechen, wobei die Phasen mithilfe eines isolierten Abschnitts X' und Y' vervollständigt werden, der zu den anderen zwei Leitern Z gehört, welche die dritte Phase Ø4 festlegen.

8. Elektrizitäts-Umspannstation nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Realisierung mit Modulen, die mittels einer Isolation aus SF6 verbunden sind, ausgeführt ist mithilfe einer Innenanlage mit dem Layout der verschiedenen armierten Module M der Ringe in einem Gebäude E mit einer oder mehreren Höhenetagen.

9. Elektrizitäts-Umspannstation nach den vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** sie Basis- und Standard-Elemente F, G, K umfasst.

10. Elektrizitäts-Umspannstation nach Anspruch 9, **dadurch gekennzeichnet, dass** der Aufbau der elektrischen Umspannstation realisiert ist mithilfe von Standard-Basiselementen F, G, K, unabhängig oder in Teil- oder Gesamtgruppen der Elemente.

11. Elektrizitäts-Umspannstation nach einem der Ansprüche 9 und 10, **dadurch gekennzeichnet, dass** die Basis- und Standardelemente F, G, K Anschlüsse zur Verbindung miteinander oder dafür enthalten, dass das Einrichten seitlicher Ausgänge oder eine Vergrößerung der Umspannstation zugelassen ist.

12. Elektrizitäts-Umspannstation nach einem der Ansprüche 9, 10 und 11, **dadurch gekennzeichnet, dass** die Basis- und Standardelemente G die entsprechenden armierten Module M mit geeigneten Anschlüssen für die Verbindung mit anderen gleichen Basiselementen oder mit Basiselementen F und K für seitliche Ausgänge oder für Erweiterungen enthalten.

13. Elektrizitäts-Umspannstation nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Verbindungen zwischen Transportleitungen und der Umspannstation mittels eines Freileiters, isolierten Kabels, mit SF6 armierten Leitungskanal und Kombinationen daraus nicht genau bestimmbar ausgeführt sind.

14. Elektrizitäts-Unterstation nach Anspruch 1, **dadurch gekennzeichnet, dass** der Ring A' ein kompakter Ring ist, der zwei Paare von armierten Modulen M1 und M2 umfasst, entsprechend einem Layout auf zwei Ebenen N1 und N2, die mit den drei Phasen versehen sind, die auf der gleichen Ebene oder auf verschiedenen Ebenen abgetrennt sind, was die Entwicklung von Hochspannungs-Umspannstationen erlaubt, was von besonderem Interesse für 400 kV und höhere Spannungen ist.

15. Elektrizitäts-Umspannstation nach Anspruch 14, **dadurch gekennzeichnet, dass** die Module M1 und M2 einer jeden Ebene N1 und N2 an einem ihrer Enden mittels einer Schiene B1 bzw. B2 miteinander verbunden sind, während an dem anderen Ende das Modul einer jeden Ebene N1 mit demjenigen der anderen Ebene N2 mittels einer vertikalen Schiene B4 verbunden ist, was das entsprechende elektrische Ring-Layout festlegt.

16. Elektrizitäts-Umspannstation nach einem der Ansprüche 14 und 15, **dadurch gekennzeichnet, dass** der kompakte Ring A' modular auf zwei Ebenen N1 und N2 ist, was einen Satz oder einen Ring mit vier Eingängen/Ausgängen festlegt, was das Hinzufügen eines weiteren Satzes oder Sätzen von Ringen A'' erlaubt, die mit den gleichen Kennwerten versehen sind, um eine Vergrößerung der Umspannstation zu erreichen, wobei jeder zusätzliche Satz A'' drei armierte Module und zwei Eingänge/Ausgänge umfasst, wobei das verbleibende armierte Modul mittels eines einfachen Anschlusses realisiert ist.

Revendications

1. Sous-station électrique, définie par:

- une configuration électrique comprenant des interconnexions d'éléments qui forment la sous-station électrique, sélectionnés parmi: des disjoncteurs, des déconnecteurs, des transformateur de mesure d'intensité, des transformateurs de mesure de tension, des barres électriques et des combinaisons de ceux-ci;
- une technologie d'isolation électrique utilisée, sélectionnée parmi: une isolation extérieure qui utilise l'air comme isolant diélectrique, et des éléments enveloppés à l'intérieur de modules blindés dans un environnement isolant sélectionné entre le SF_6 (l'hexafluorure de soufre) et d'autres isolants; et
- une disposition physique de phases électriques,

la technologie d'isolation électrique comprenant des chambres indépendantes et isolées au moyen dudit environnement isolant, pour des éléments sélectionnés parmi le disjoncteur I, les transformateurs de mesure d'intensité TI, les déconnecteurs S et les déconnecteurs de mise à la terre S'; et
la disposition physique des phases électriques est mise en oeuvre d'une manière distincte, permettant une connexion de positions d'entrée/sortie L convergentes, indépendamment de leur disposition dans le cas où les positions d'entrée/sortie L sont des lignes, évitant le croisement de lignes et de routes environnantes, permettant aussi qu'une disposition physique des modules blindés M soit sélectionnée entre une disposition en anneau, en ligne et mixte;
ladite sous-station électrique étant **caractérisée en ce que**:

la disposition électrique est mise en oeuvre au moyen de modules blindés monophasés M, qui forment des carrés électriques reliés de façon longitudinale, des positions respectives L faisant saillie à partir de chacun desdits carrés électriques; chacun des modules blindés M étant constitué par: un disjoncteur I, deux transformateurs de mesure d'intensité TI, deux déconnecteurs S et deux déconnecteurs de mise à la terre S'.

2. Sous-station électrique selon la revendication 1, **caractérisée en ce que** les modules blindés M sont interconnectés au moyen d'un câble ou d'un tube d'aluminium nu, et/ou au moyen d'un conduit blindé isolé au SF_6.

3. Sous-station électrique selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la disposition "en anneau" peut être fermée au moyen d'un conducteur C qui joint les extrémités longitudinales qui correspondent à l'arrangement des modules blindés M qui sont interconnectés les uns aux autres.

4. Sous-station électrique selon l'une quelconque des revendications précédentes, **caractérisée en ce que** dans chaque position d'entrée/sortie L des anneaux A, trois transformateurs de mesure de tension TT sont inclus, un premier qui est connecté au noeud associé de l'anneau respectif A, et les deux autres qui sont connectés après le déconnecteur de sortie S', qui est placé dans la position d'entrée/sortie L.

5. Sous-station électrique selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la configuration "en anneau" est employée de manière à réaliser un agrandissement d'une configuration conventionnelle, en la connectant à ladite configuration conventionnelle, déterminant des configurations mixtes.

6. Sous-station électrique selon l'une quelconque des revendications précédentes, **caractérisée en ce que** l'activation des phases Ø0, Ø4, Ø8 d'une manière distincte est accomplie au moyen d'une installation externe, au moyen d'une disposition des conducteurs qui correspond aux phases, à un ou deux niveau(x) de hauteur, alors que les anneaux A constitués par des modules blindés M sont agencés à un niveau inférieur et sont connectés de façon indépendante aux phases Ø0, Ø4, Ø8, les trois phases de chaque niveau de connexion étant définies par quatre conducteurs X, Y, Z, où chaque conducteur est constitué de plusieurs sections qui sont susceptibles d'être connectées les unes aux autres au moyen de ponts P dans le but d'établir une continuité électrique dans chaque conducteur ou chaque phase, et dans le but d'établir l'interconnexion des différentes entrées/sorties aux noeuds V et V' des anneaux A les plus pratiques, indépendamment de la topologie de l'arrivée des entrées/sorties à la sous-station, deux de ces conducteurs correspondant uniquement aux deux phases, qui sont complétées au moyen d'une section isolée qui appartient aux deux autres conducteurs qui correspondent à la troisième phase.

7. Sous-station électrique selon la revendication 6, **caractérisée en ce que**, lors de l'activation des phases Ø0, Ø4, Ø8 d'une façon distincte, deux des conducteurs (X et Y, par exemple) correspondent aux deux phases Ø0 et Ø8, lesdites phases étant complétées au moyen d'une section isolée X' et Y' qui appartient aux deux autres conducteurs Z qui déterminent la troisième phase Ø4.

8. Sous-station électrique selon l'une quelconque des revendications précédentes, **caractérisée en ce que**, avec les modules connectés au moyen d'une isolation au SF_6, l'activation est accomplie au moyen d'une installation intérieure avec la disposition des différents modules blindés M des anneaux, dans un bâtiment E avec un ou plusieurs étages en hauteur.

9. Sous-station électrique selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle comprend des éléments de base et standardisés F, G, K.

10. Sous-station électrique selon la revendication 9, **caractérisée en ce que** la composition de la sous-station électrique est activée au moyen des éléments de base standards F, G, K, de façon indépendante, ou en groupes partiels ou complets desdits éléments.

11. Sous-station électrique selon l'une quelconque des revendications 9 et 10, **caractérisée en ce que** les éléments de base et standards F, G, K comprennent des connexions pour être connectés les uns aux autres, ou pour permettre d'établir des sorties latérales, ou pour réaliser un agrandissement de la sous-station.

12. Sous-station électrique selon l'une quelconque des revendications 9, 10 et 11, **caractérisée en ce que** les éléments de base et standards G comprennent les modules blindés M correspondants avec des connexions appropriées pour réaliser une connexion avec d'autres éléments de base similaires, ou avec des éléments de base F et K pour des sorties latérales ou pour des agrandissements.

13. Sous-station électrique selon l'une quelconque des revendications précédentes, **caractérisée en ce que** les connexions entre les lignes de transport et la sous-station sont établies de façon indistincte au moyen d'un conducteur aérien, d'un câble isolé, de conduits blindés isolés au SF_6 et de combinaisons de ceux-ci.

14. Sous-station électrique selon la revendication 1, **caractérisée en ce que** l'anneau A' est un anneau compact qui comprend deux paires de modules blindés M1 et M2, selon une disposition à deux niveaux N1 et N2, pourvue des trois phases distinctes situées au même niveau ou à des niveaux différents, permettant le développement de sous-stations à haute tension, particulièrement intéressantes pour des tensions de 400 kV, et plus.

15. Sous-station électrique selon la revendication 14, **caractérisée en ce que** les modules M1 et M2 de chaque niveau N1 et N2 sont joints l'un à l'autre à l'une de leurs extrémités au moyen d'une barre B1 et B2, respectivement, alors qu'à l'autre extrémité le module de chaque niveau N1 est joint à celui de l'autre niveau N2, au moyen d'une barre verticale B4, déterminant la disposition électrique en anneau correspondante.

16. Sous-station électrique selon l'une quelconque des revendications 14 et 15, **caractérisée en ce que** l'anneau compact A' est modulaire à deux niveaux N1 et N2, déterminant un ensemble d'anneau comprenant quatre entrées/sorties, permettant d'ajouter un ou plusieurs autre(s) d'ensemble(s) d'anneaux A" qui présente(nt) les mêmes caractéristiques, dans le but de réaliser un agrandissement de la sous-station, chaque ensemble A" supplémentaire comprenant trois modules blindés et deux entrées/sorties, le module blindé restant étant activé au moyen d'une simple connexion.

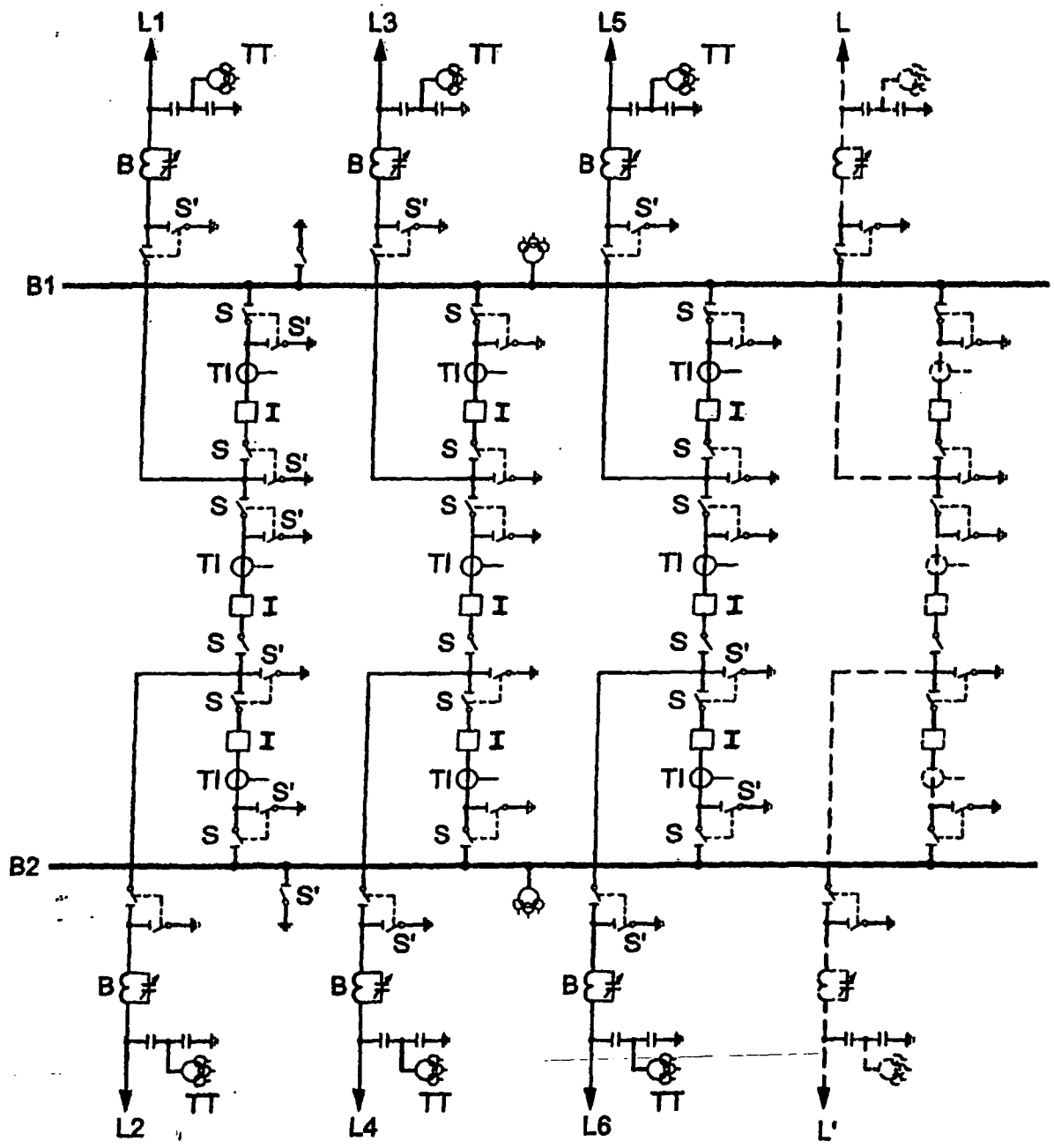


FIG.1

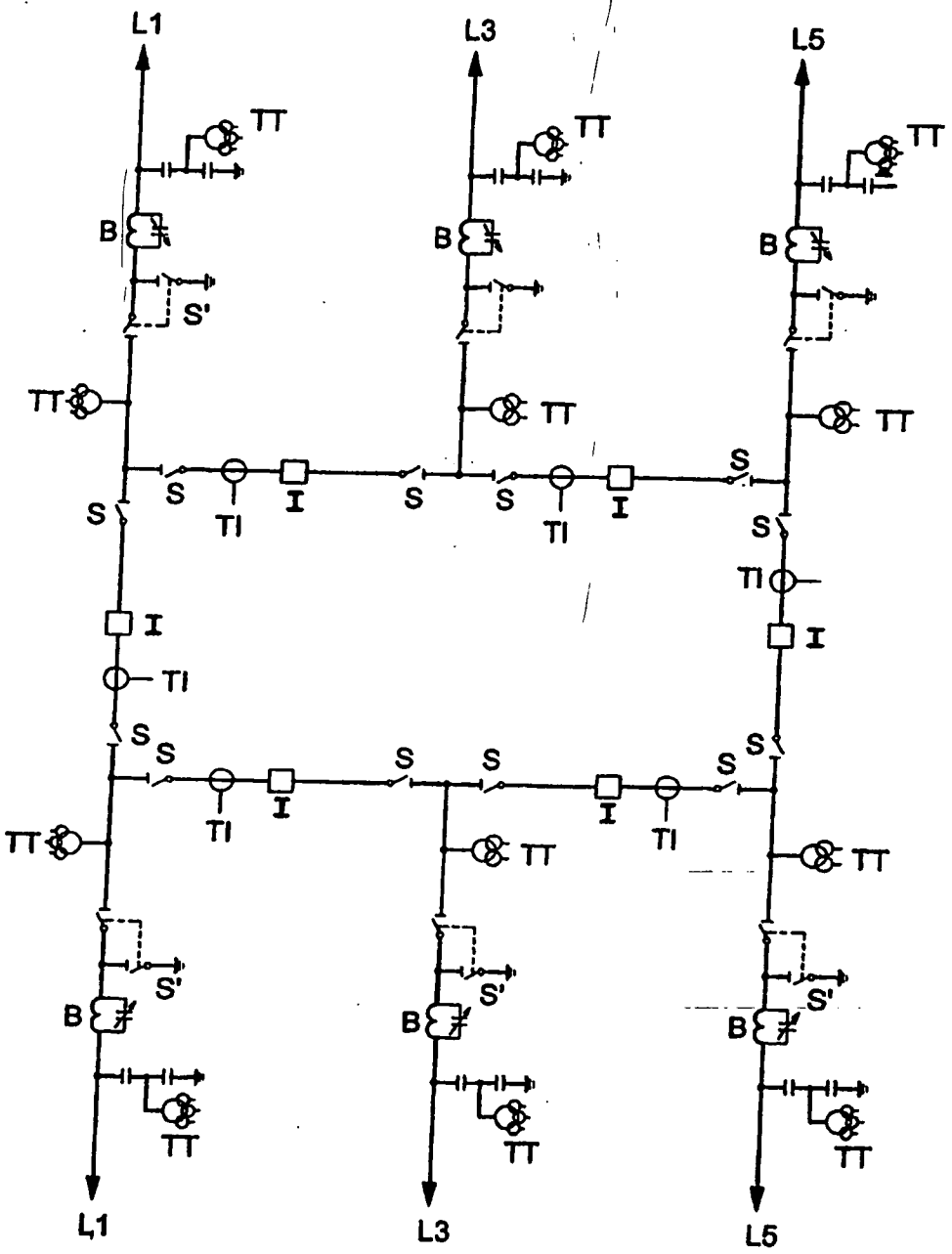


FIG.2

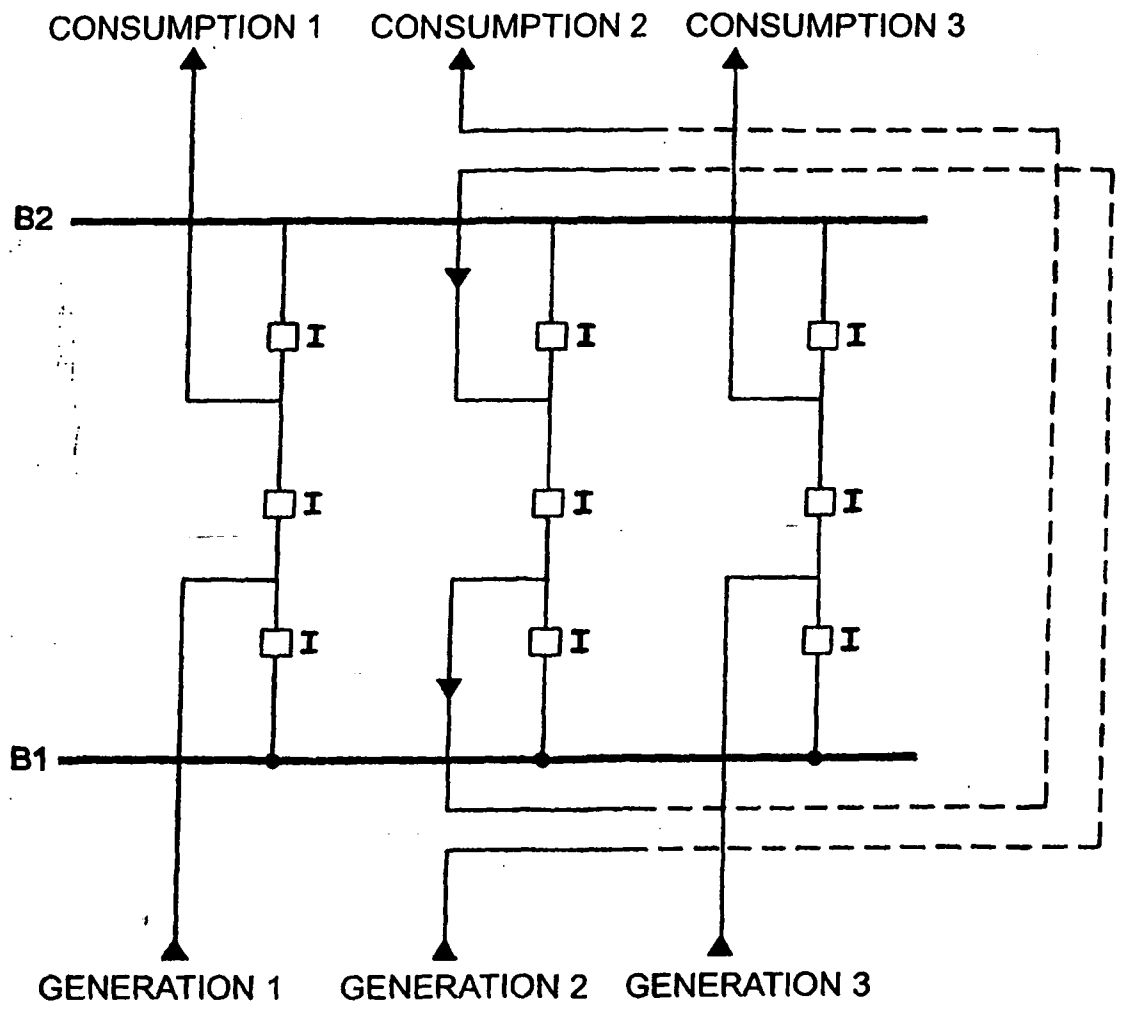

CONSUMPTION 1
CONSUMPTION 2
CONSUMPTION 3
B2
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B1
GENERATION 1
GENERATION 2
GENERATION 3

FIG.3

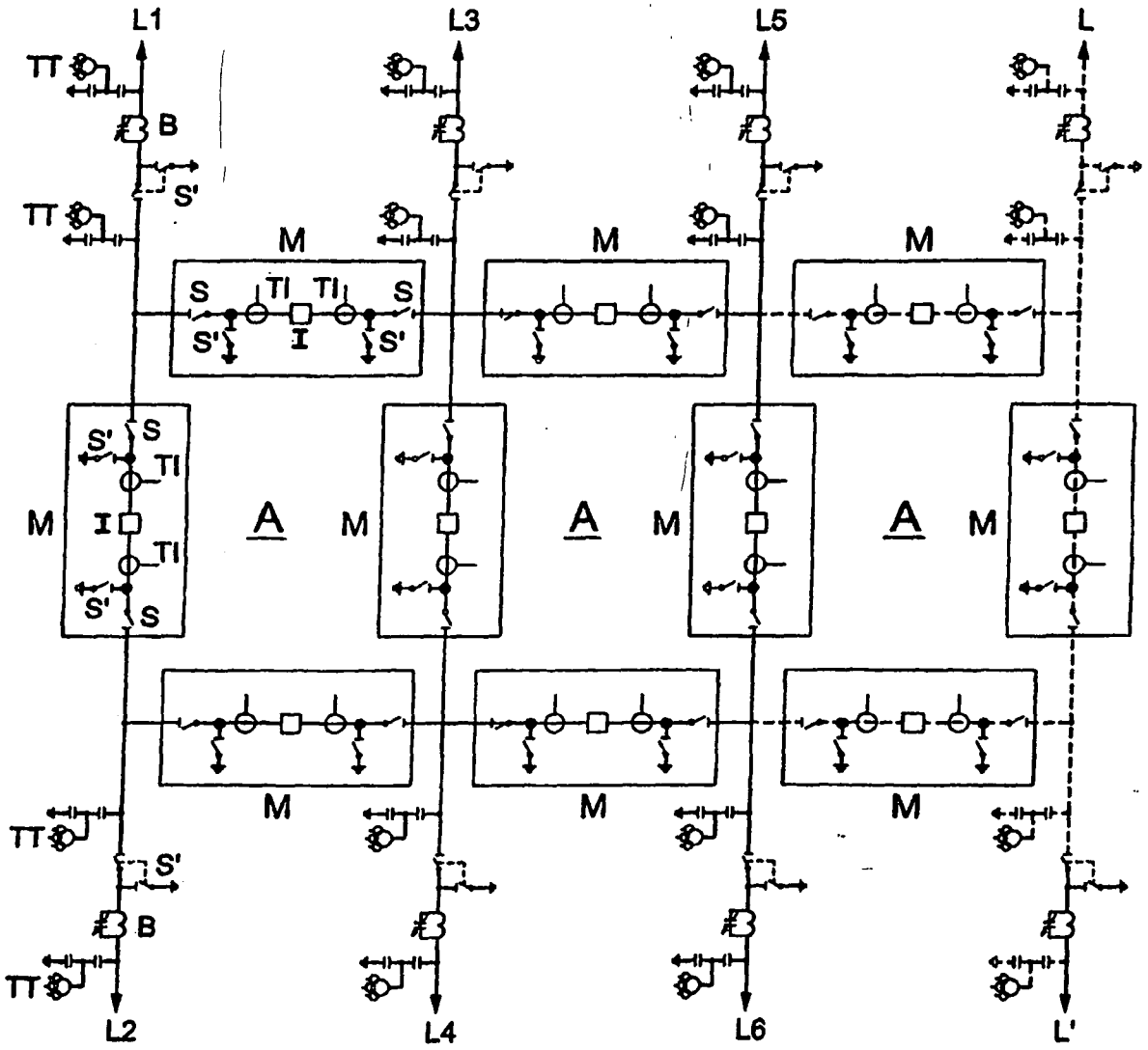


FIG.4

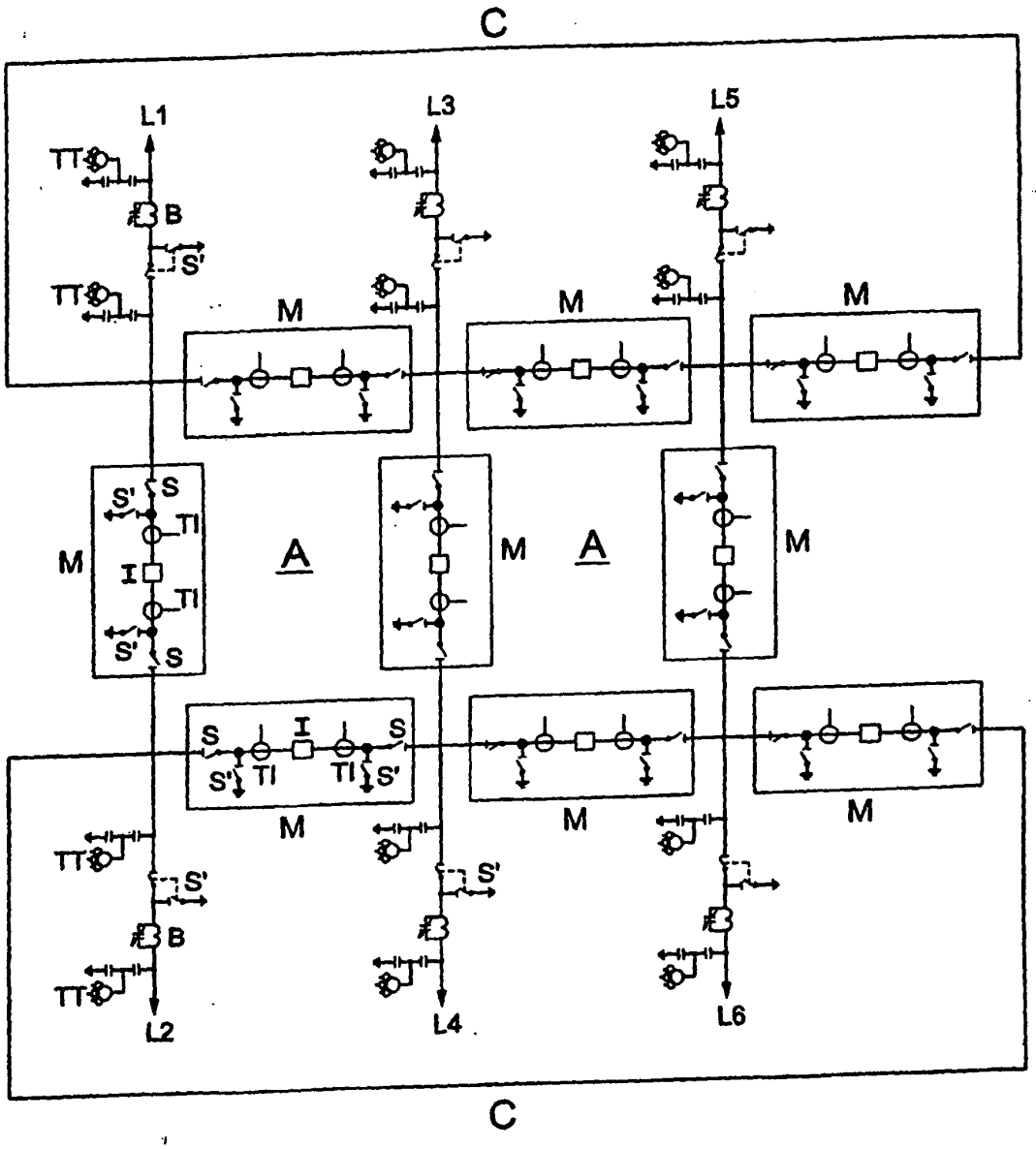

C
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TT
S'
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S'
L2
L4
L6
C

FIG.5

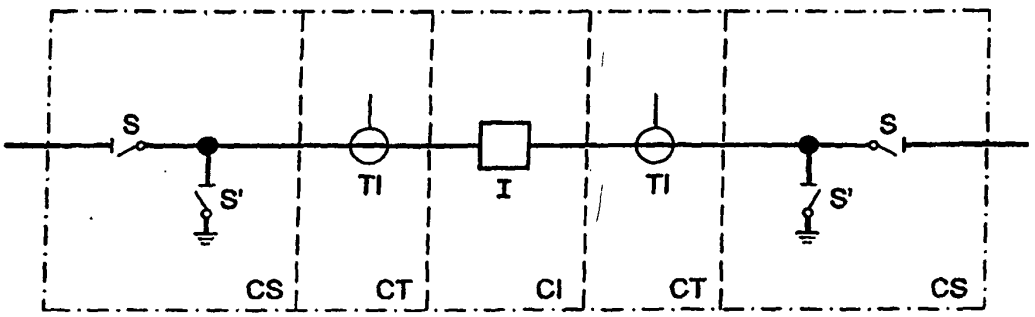


FIG.6

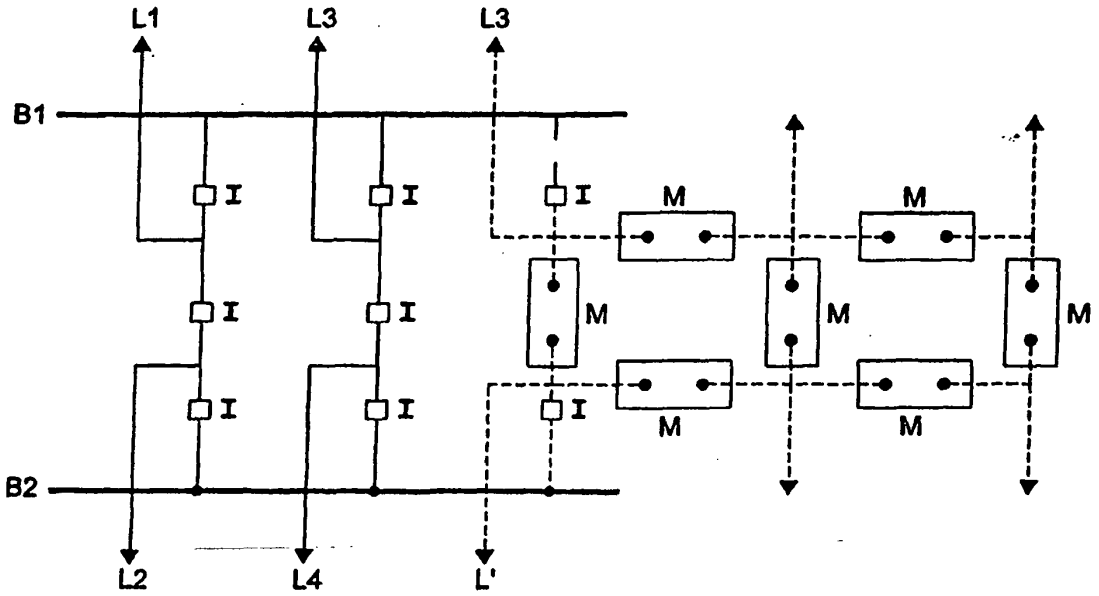


FIG.7

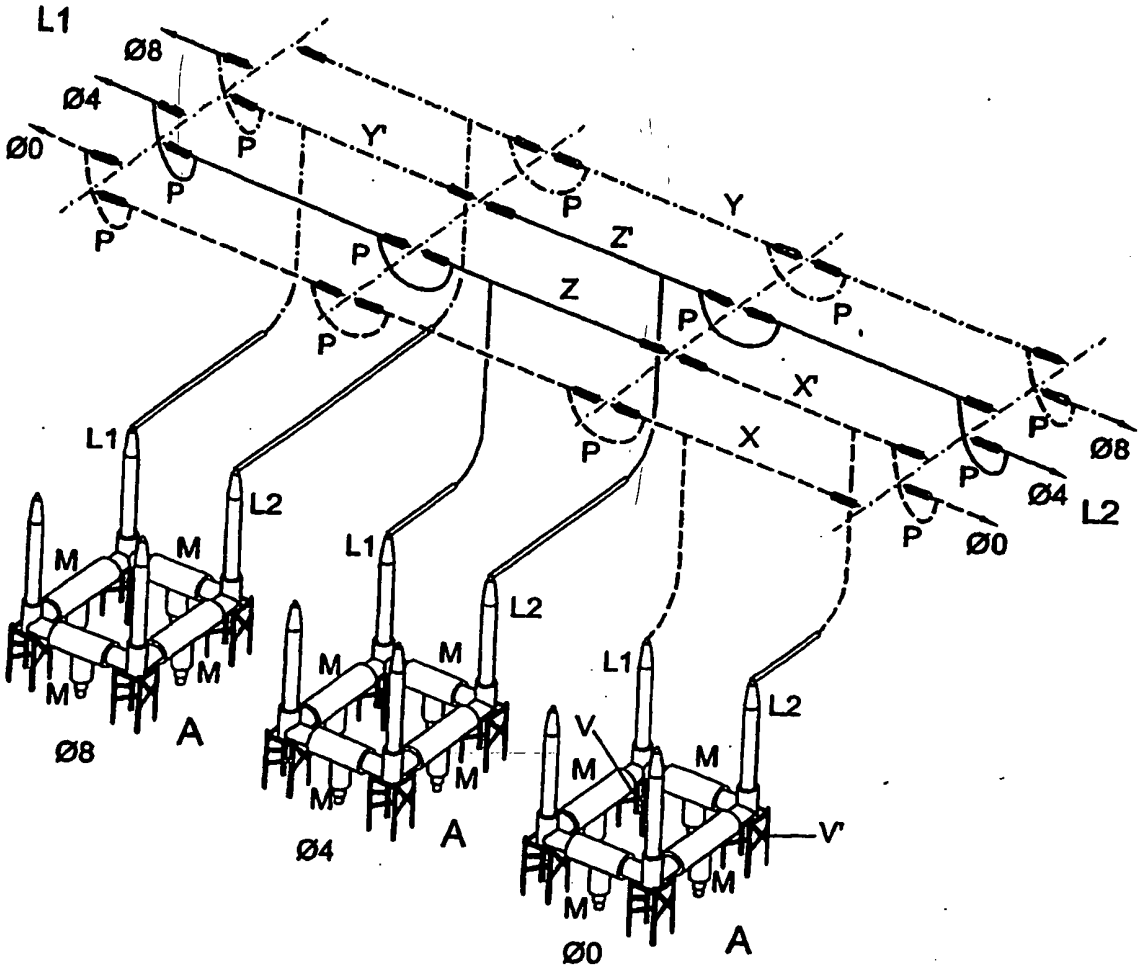


FIG.8

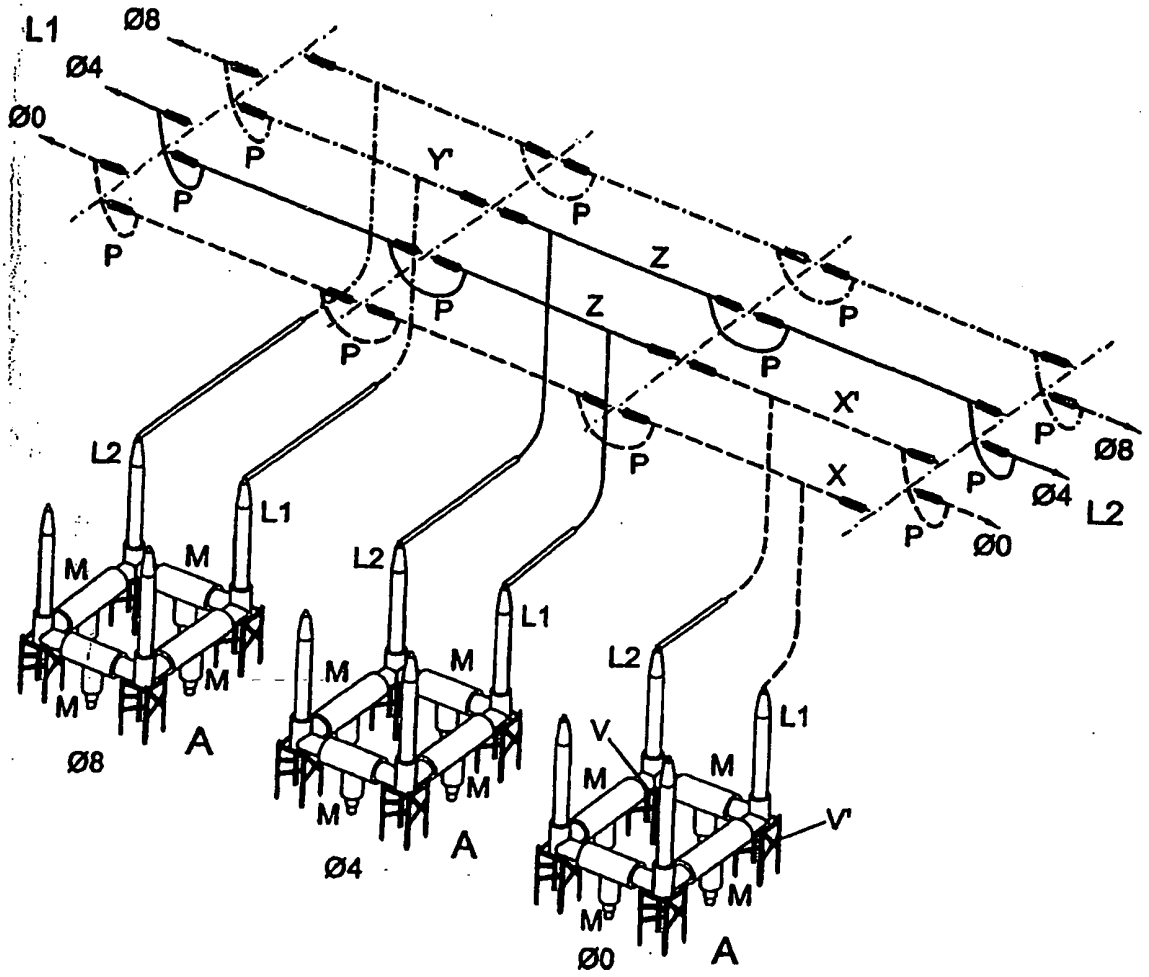


FIG.9

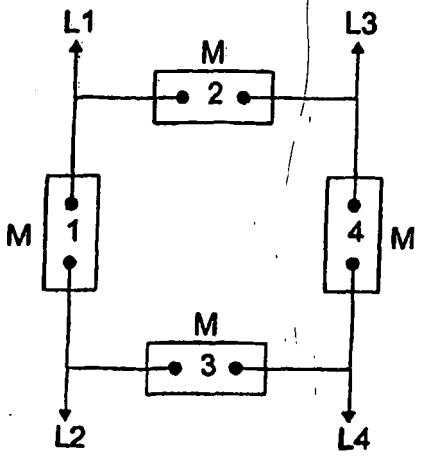


FIG.10

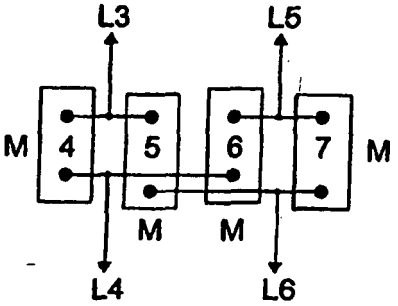


FIG.11

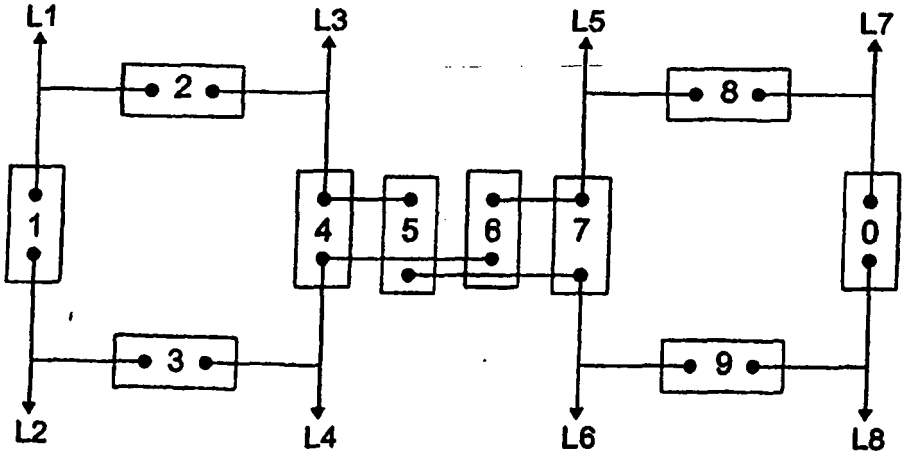


FIG.12

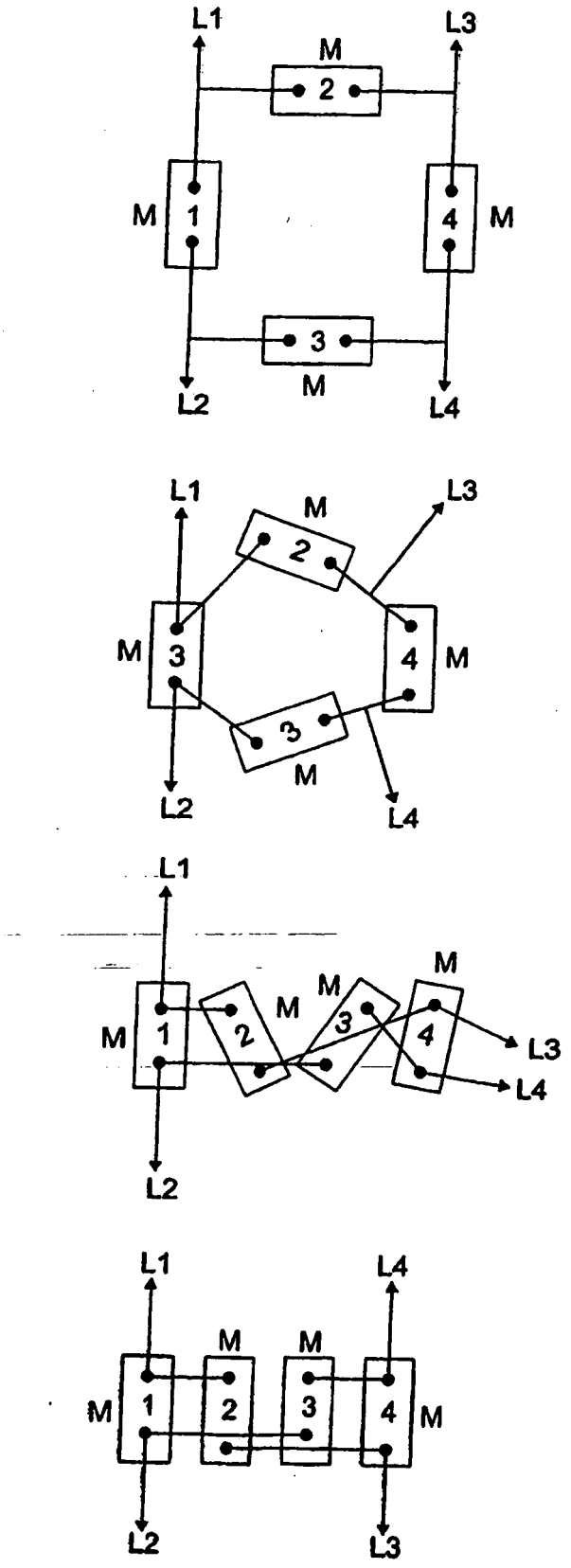

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M
L2
L3

FIG.13

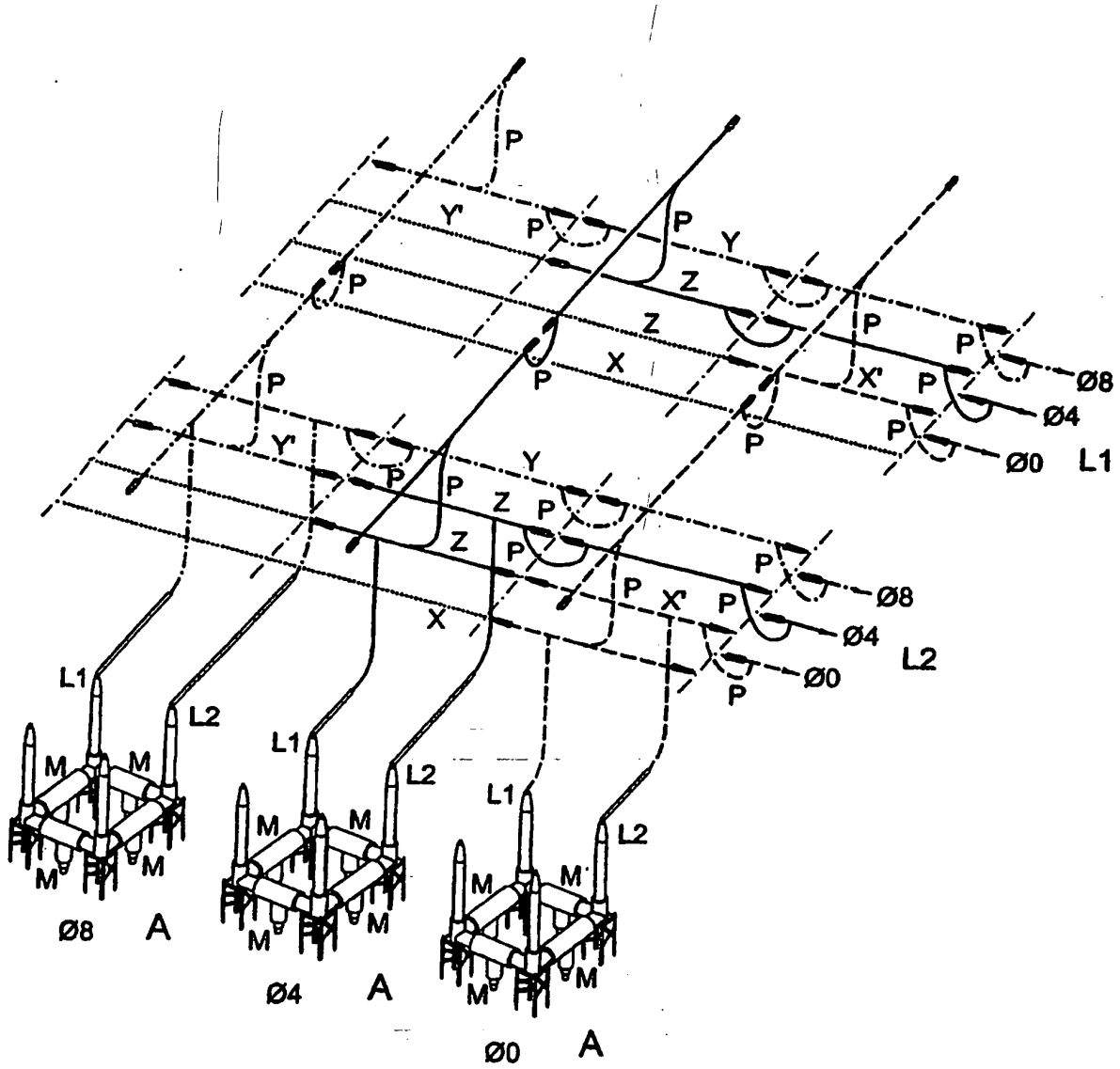


FIG.14

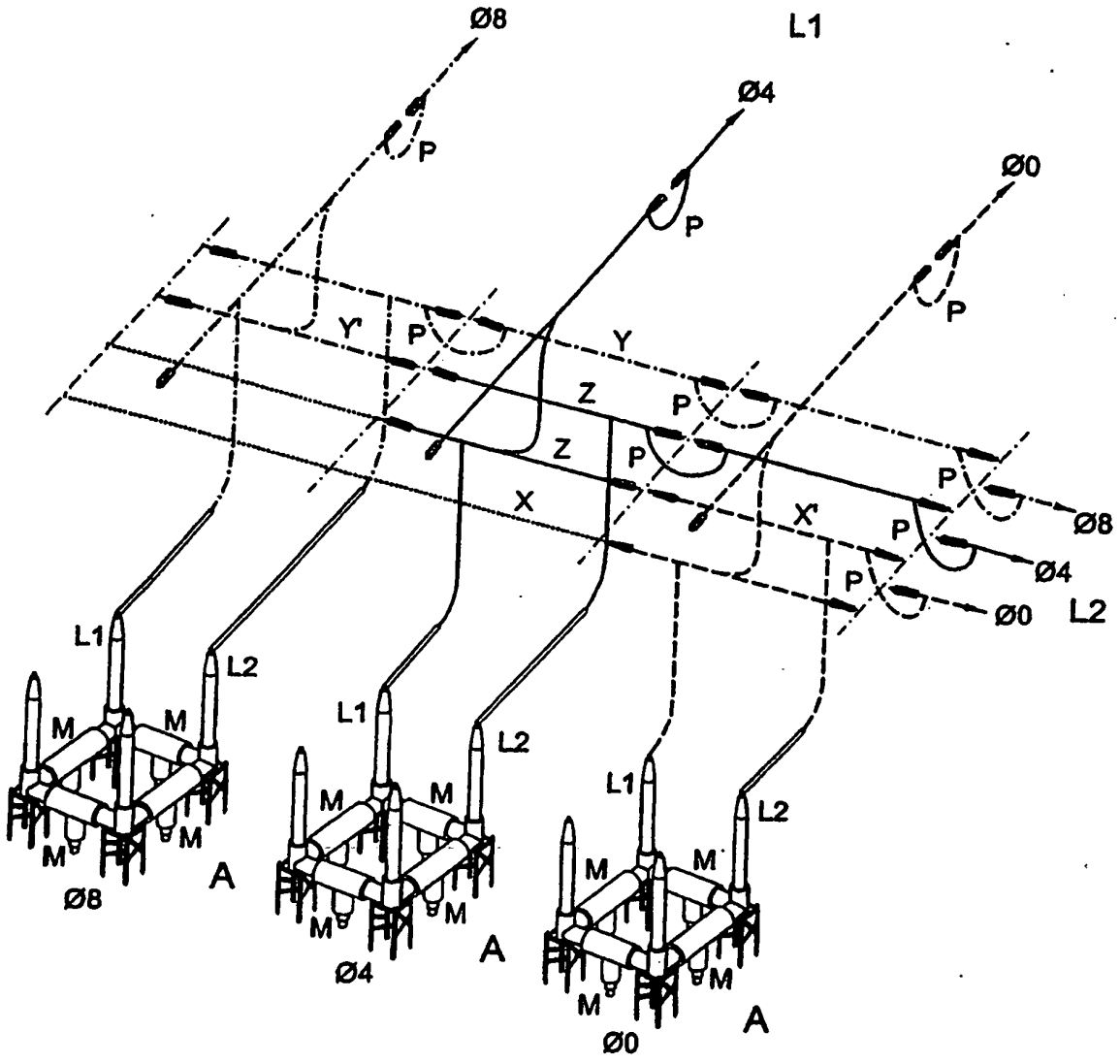


FIG.15

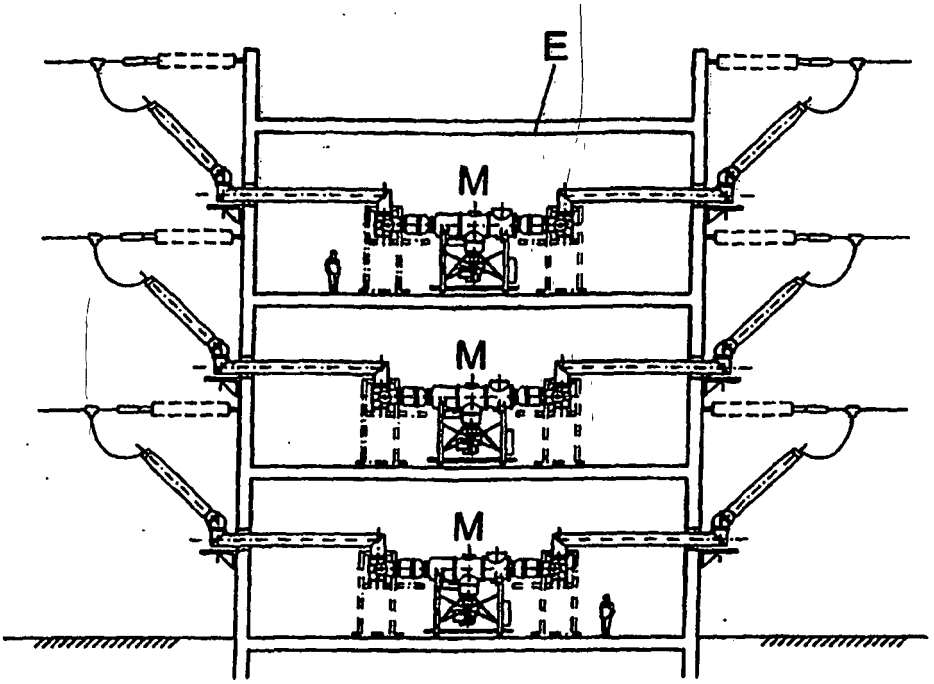


FIG.16

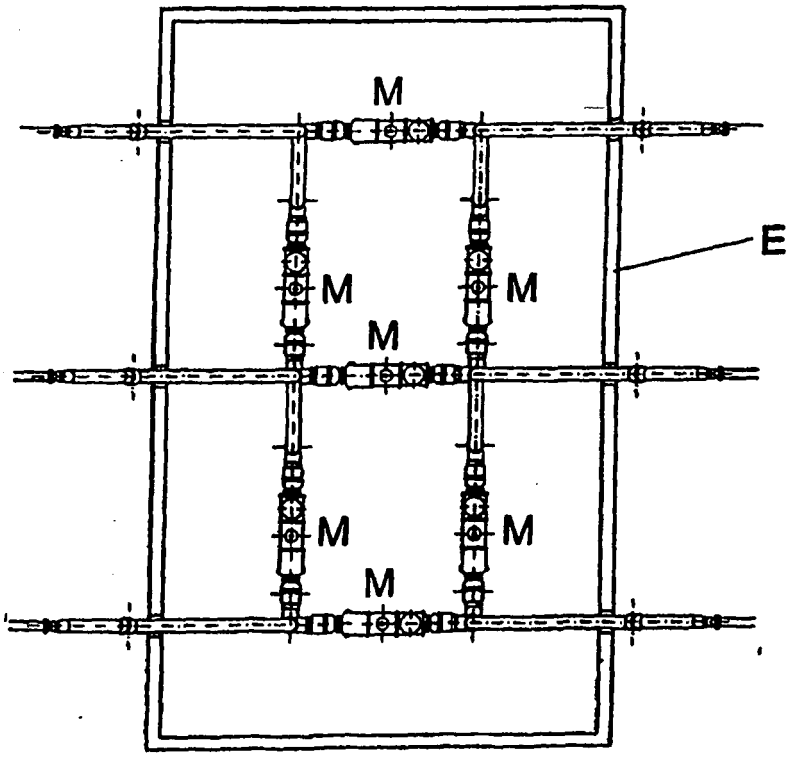


FIG.17

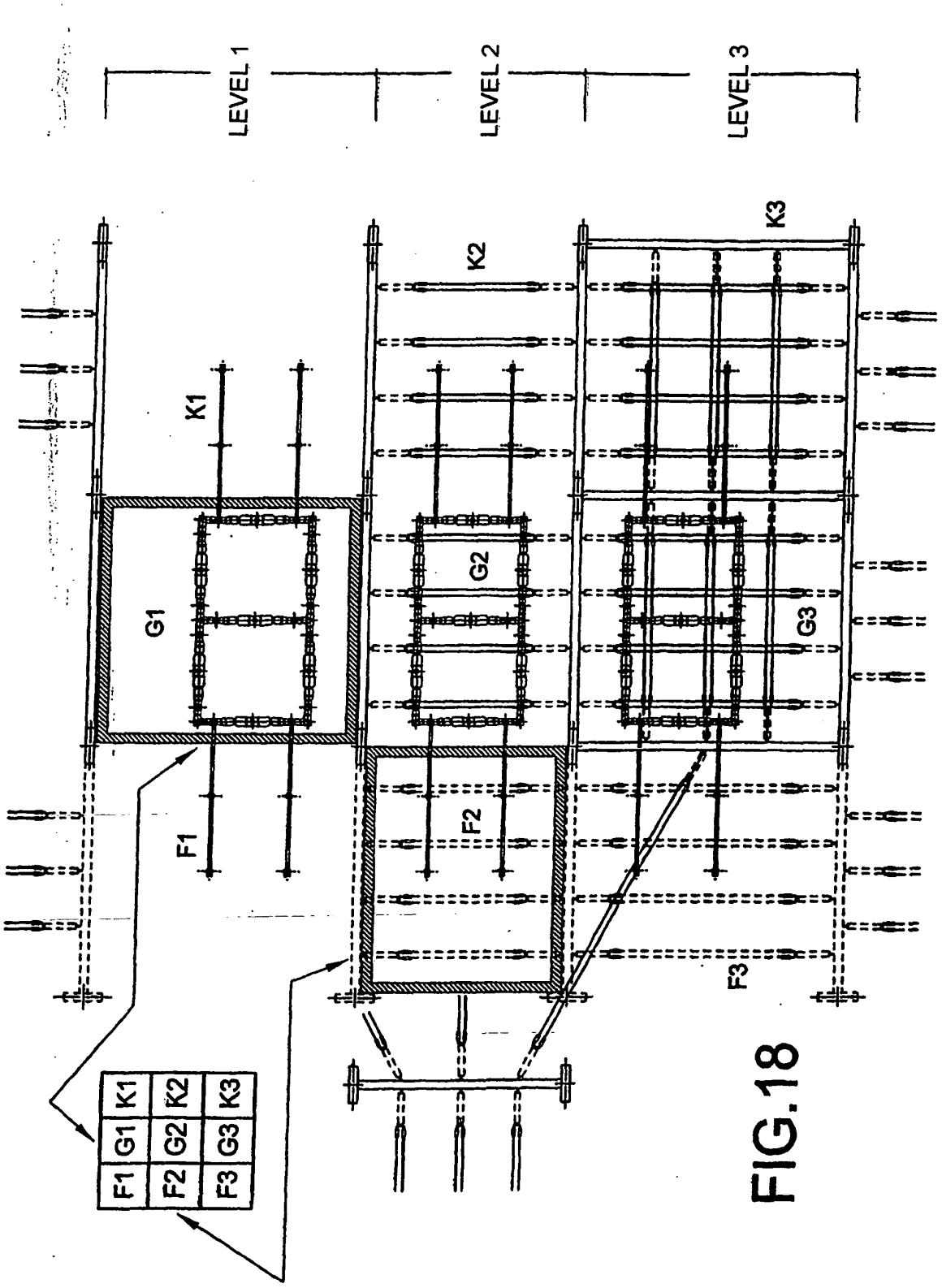

LEVEL 1
LEVEL 2
LEVEL 3
K1
K2
K3
G1
G2
G3
F1
F2
F3
K1 K2 K3
G1 G2 G3
F1 F2 F3

FIG.18

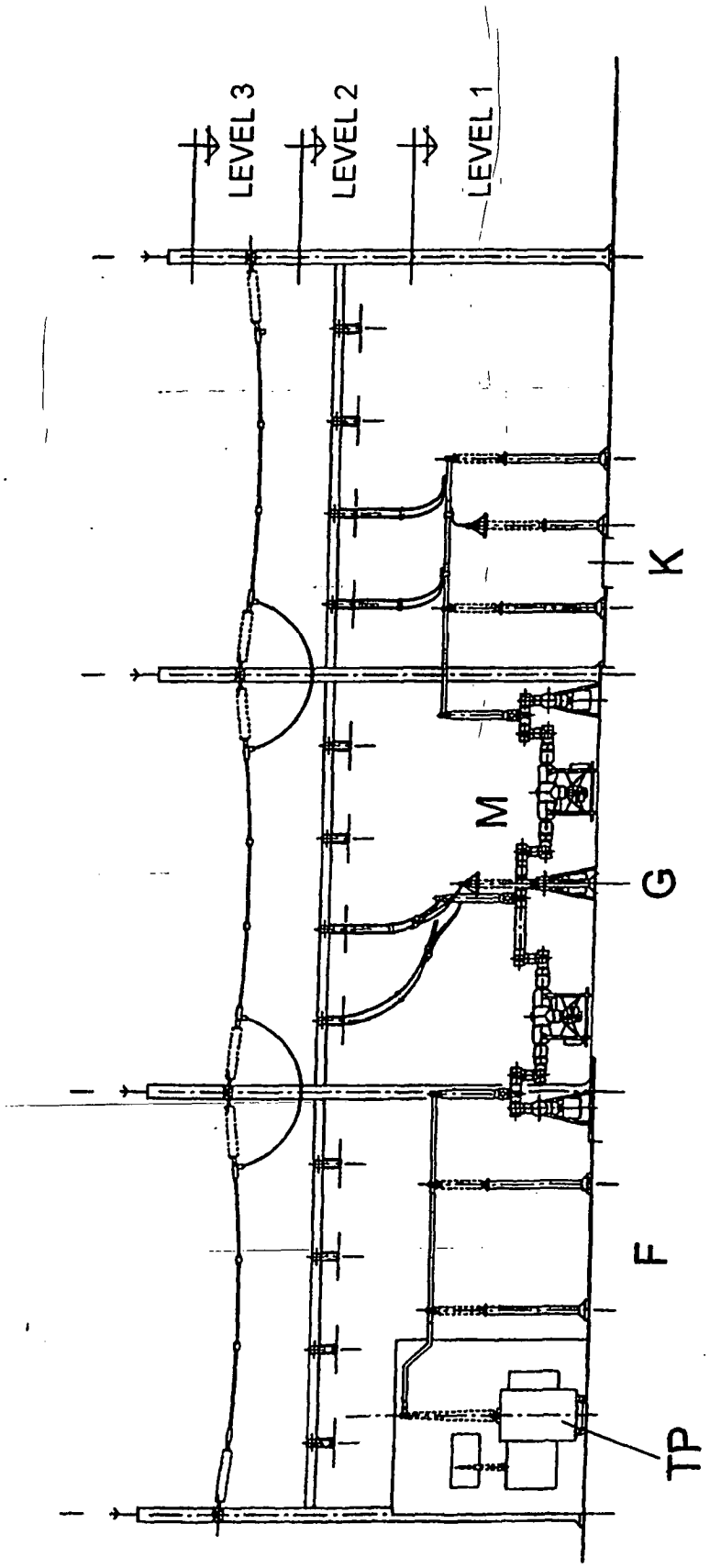


FIG.19

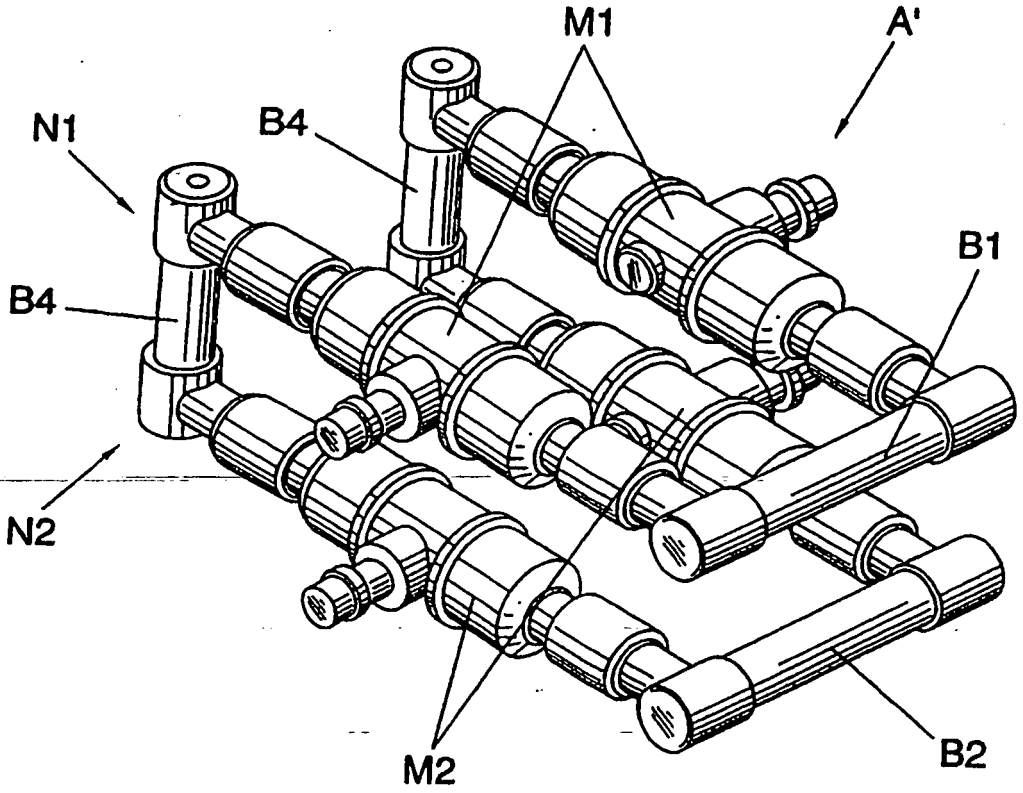


FIG.20

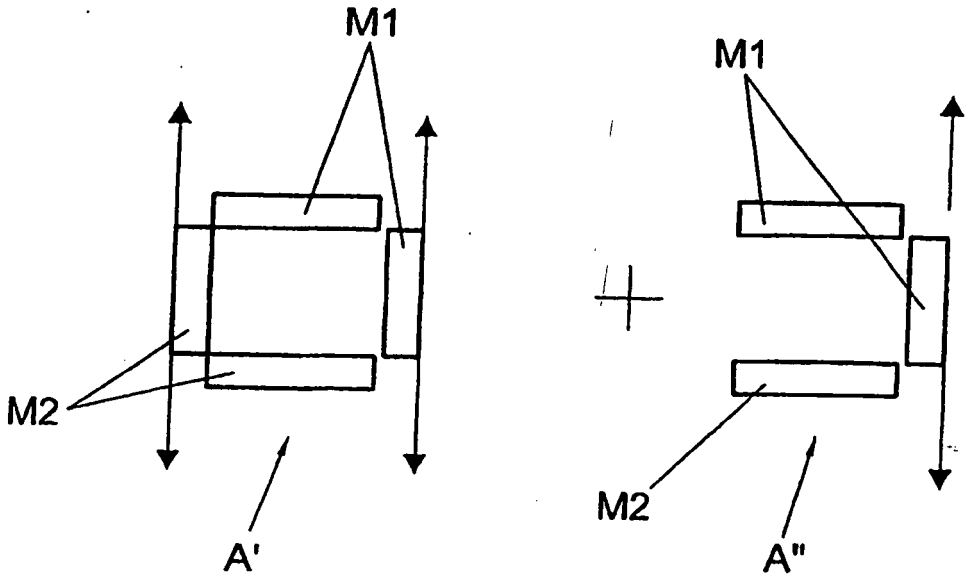


FIG.21

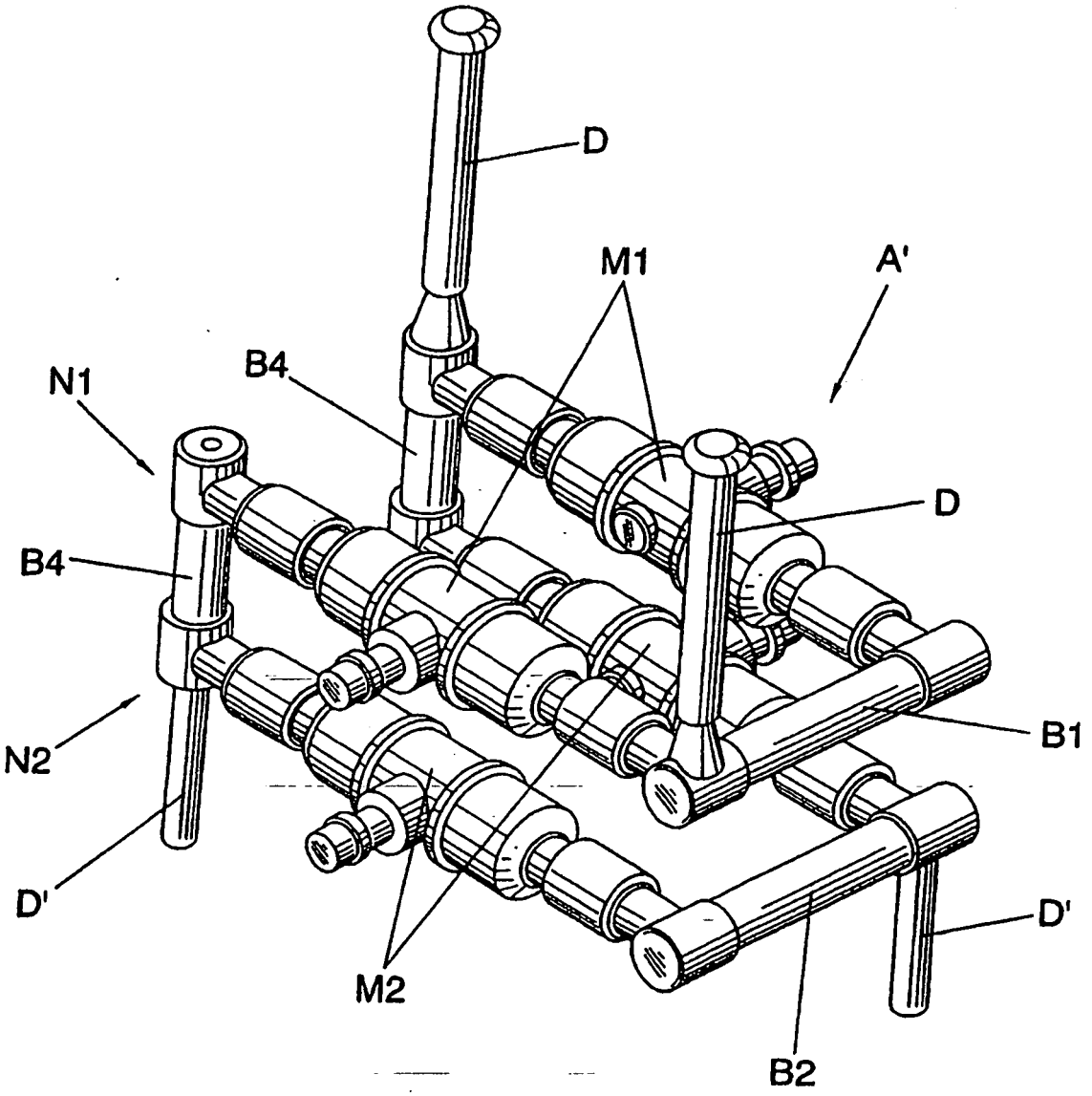


FIG.22

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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